

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TETRA TECH CANADA INC.,
Petitioner,

v.

GEORGETOWN RAIL EQUIPMENT COMPANY,
Patent Owner.

IPR2019-00620
Patent 9,441,956 B2

Before HUBERT C. LORIN, BENJAMIN D. M. WOOD, and
KRISTINA M. KALAN, *Administrative Patent Judges*.

KALAN, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision

Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

Denying Patent Owner's Contingent Motion to Amend
35 U.S.C. § 316(d)

I. INTRODUCTION

Tetra Tech Canada Inc. (“Petitioner”) filed a Petition requesting *inter partes* review of claims 1–3, 7–13, and 16–20 of U.S. Patent No. 9,441,956 B2 (Ex. 1001, “the ’956 patent”). Paper 2 (“Pet.”). Georgetown Rail Equipment Company (“Patent Owner”) filed a Preliminary Response to the Petition. Paper 7 (“Prelim. Resp.”). We instituted an *inter partes* review of claims 1–3, 7–13, and 16–20 of the ’956 patent on all grounds of unpatentability alleged in the Petition. Paper 8 (“Institution Decision” or “Dec.”).

After institution of trial, Patent Owner filed a Patent Owner Response. Paper 10 (“PO Resp.”). Patent Owner also filed a Contingent Motion to Amend. Paper 11 (“Motion”). The Motion requests the Board cancel original claims 1–3, 7–13, and 16–20, if those claims are found unpatentable, and replace each unpatentable claim with corresponding proposed substitute claims 30–44. *Id.* at 1. Subsequently, Petitioner filed an Opposition to the Motion to Amend. Paper 16 (“Opp.”). Petitioner also filed a Reply. Paper 15 (“Reply”). A consolidated oral hearing with related cases IPR2019-00619 and IPR2019-00662 was held on May 18, 2020, and a transcript of the hearing is included in the record. Paper 25 (“Tr.”).

This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a). For the reasons that follow, we determine that Petitioner has established by a preponderance of the evidence that claims 1–3, 7–13, and 16–20 of the ’956 patent are unpatentable.

We also determine that Petitioner has established by a preponderance of the evidence that Patent Owner’s proposed substitute claims 30–44 are

unpatentable, and, therefore, we deny Patent Owner's Contingent Motion to Amend.

A. Related Proceedings

The parties identify the following proceeding as involving the '956 patent: *Georgetown Rail Equipment Company v. Tetra Tech Canada Inc.*, No. 6:18-cv-377 (E.D. Tex.). Pet. 4; Paper 4, 2. The parties also state that the '956 patent is the subject of an additional Board proceeding, IPR2019-00662. Pet. 2; Paper 4, 2.

B. The '956 Patent

The '956 patent, titled "System and Method for Inspecting Railroad Ties," discloses "systems and methods for inspection and grading of wood railroad ties." Ex. 1001, code (54), 1:28–29. In particular, the '956 patent describes a "computerized system and method for inspecting railroad tracks, which can both identify and locate railroad ties, tie plates, and appurtenant structures, and also determine condition metrics" of these, and further "can provide a condition grade or score for railroad ties and other features." *Id.* at 2:15–22. The system can scan and grade the condition of the railroad ties by capturing images of a railroad track and then analyzing those captured images. *Id.* at 14:24–27, 14:42–46. Figures 1 and 2 illustrate an inspection system used to capture images of the railroad track, and are reproduced below.

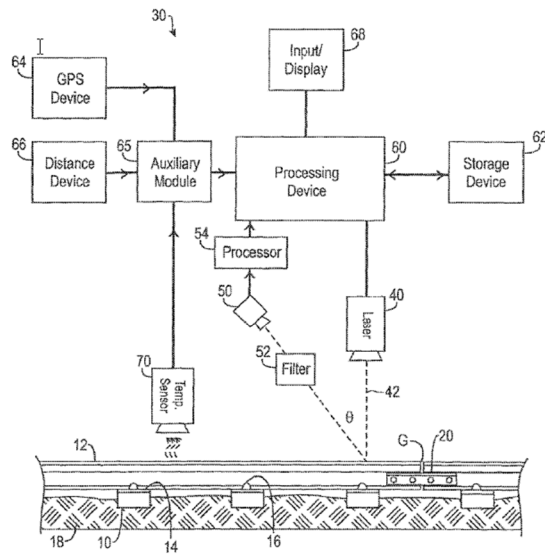


FIG. 1

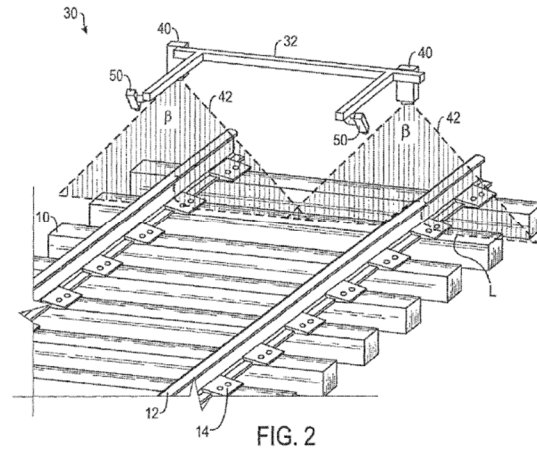


FIG. 2

Figures 1 and 2 show systems for inspecting railroad tracks. *Id.* at 3:24–28. As shown in both figures, “inspection system 30 includes a light generator such as a laser 40” which “projects a beam 42 of laser light at the track bed.” *Id.* at 4:24–25, 4:39–40. As shown in Figure 2, “beam 42 produces a projected line L.” *Id.* at 4:40–41. Projected line L “follows the contours of the surfaces and components of the track bed,” e.g., the “crossties 10, rails 12, tie plates 14, spikes 16, and ballast 18” (*id.* at 4:38–43) and, further, projected line L “is substantially straight and extends substantially across the track bed” (*id.* at 5:11–12, 18–20). Then, “a device for receiving light reflected from the area to be inspected such as a camera 50” captures “an image of the line L of laser light 42 projected on the track bed.” *Id.* at 4:26–27, 4:43–45. “The camera 50 sends the captured image to the processing device 60 for processing and analysis.” *Id.* at 4:45–46.

Processing and analysis of the captured image allows the inspection system “to determine various condition metrics of the ties.” *Id.* at 18:10–12. The condition metrics “can include a variety of factors that relate to the

function and longevity of railroad ties,” e.g., “tie warpage . . . tie height and tie surface roughness,” (*id.* at 18:14–21) and “tie plate cut (i.e. a measurement of the depth that a tie plate has worn, pressed or cut into a tie’s surface)” (*id.* at 19:4–7). Further, once the “various tie condition metrics have been determined, the system can be configured to generate or compute a condition grade or score for each tie. This can be done by applying a weight factor to each of the condition metrics.” *Id.* at 21:4–8.

C. Illustrative Claim

Of challenged claims 1–3, 7–13, and 16–20, claims 1, 8, and 17 are independent. Claim 1 is reproduced below:

1. [pre] A system for inspecting railroad ties, comprising:
 - [a] a. a rail vehicle, configured for moving along a railroad track in a travel direction;
 - [b] b. a light generator, attached to the rail vehicle, oriented to project a beam of light across the railroad track while moving thereon;
 - [c] c. an optical receiver, attached to the rail vehicle, oriented to receive at least a portion of the beam of light reflected from the railroad track and configured to generate image data representative of a profile of at least a portion of the railroad track; and
 - [d] d. a processor, configured to analyze the image data by applying one or more algorithms configured to:
 - [e] i. find boundaries of at least one railroad tie in the railroad track; and
 - [f] ii. determine the condition of the at least one railroad tie by:
 - a. determining a series of condition metrics of the at least one railroad tie;
 - b. applying a weight factor to each condition metric; and
 - c. computing a condition grade of the at least one railroad tie based on the weighted condition metrics.

Ex. 1001, 23:36–58 (bracketed annotations added).

D. Asserted Grounds of Unpatentability

We instituted *inter partes* review of claims 1–3, 7–13, and 16–20 of the '956 patent on the following grounds. Dec. 5, 24.

Reference(s)/Basis	35 U.S.C. § ¹	Claims
Villar, ² Haas, ³ Uzarski ⁴	103	1–3, 7, 8, 11–13, and 16–20
Villar, Haas, Uzarski, Velten, ⁵ Kanade ⁶	103	9, 10

Petitioner relies on the Declarations of Dr. Nikos Papanikolopoulos. Exs. 1004, 1050. Patent Owner relies on the Declaration of Dr. Alan Conrad Bovik. Ex. 2001.

II. ANALYSIS

A. Legal Standards

A 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 to a person of ordinary skill in the art at the time the invention was made. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). Obviousness is resolved based on

¹ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 103, effective March 16, 2013. Because the application from which the '956 patent issued was filed before this date, the pre-AIA version of § 103 applies.

² U.S. Pat. No. 7,616,329 B2, issued November 10, 2009 (Ex. 1036).

³ U.S. Pub. No. 2012/0263342 A1, published October 18, 2012 (Ex. 1037).

⁴ Uzarski, D. R., *Development of Condition Indexes for Low Volume Railroad Track* (1993) (Ex. 1038).

⁵ Velten, J. et al., *Application of a Brightness-Adapted Edge Detector for Real-Time Railroad Tie Detection in Video Images* (1999) (Ex. 1041).

⁶ Kanade, Takeo, *Three-Dimensional Machine Vision* (1987) (Ex. 1010).

underlying factual determinations, including: (1) the scope and content of the prior art; (2) differences between the prior art and the claims at issue; (3) the level of ordinary skill in the art; and (4) objective evidence of nonobviousness, i.e., secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). Secondary considerations may include the following: “commercial success, long felt but unsolved needs, failure of others, etc.”⁷ *Id.* The totality of the evidence submitted may show that the challenged claims would not have been obvious to one of ordinary skill in the art. *In re Piasecki*, 745 F.2d 1468, 1471–72 (Fed. Cir. 1984).

Petitioner bears the burden of proving unpatentability of the challenged claims, and the burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). Petitioner must demonstrate unpatentability by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d); *see also Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). A party that petitions the Board for a determination of obviousness must show that “a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.” *Procter & Gamble Co. v.*

⁷ We note that Patent Owner did not present any evidence or arguments directed to secondary considerations during this proceeding.

Teva Pharms. USA, Inc., 566 F.3d 989, 994 (Fed. Cir. 2009) (quoting *Pfizer, Inc. v. Apotex, Inc.*, 408 F.3d 1348, 1361 (Fed. Cir. 2007)).

B. Level of Ordinary Skill in the Art

Petitioner contends that a person of ordinary skill in the art “would have a bachelor’s degree in electrical engineering, computer engineering, mechanical engineering, computer science, physics, or a related field, and at least four years of experience (or the academic equivalent) in the field of computer or machine vision.” Pet. 21 (citing Ex. 1004 ¶ 42). Patent Owner states that, for purposes of its Response, “Patent Owner does not contest the level of ordinary skill in the art asserted by Petitioner.” PO Resp. 3.

Neither party argues that the outcome of this case would differ based on our adoption of any particular definition of one of ordinary skill in the art. In light of the record now before us, we find that a person of ordinary skill in the art would be an individual with at least a bachelor’s degree in electrical engineering, computer engineering, mechanical engineering, computer science, physics, or a related field, and at least four years of experience (or the academic equivalent) in the field of computer or machine vision. Ex. 1004 ¶ 42. The level of ordinary skill in the art is also reflected by the references themselves. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (“[T]he absence of specific findings on the level of skill in the art does not give rise to reversible error ‘where the prior art itself reflects an appropriate level and a need for testimony is not shown.’”); *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (finding that the Board of Patent Appeals and Interferences did not err in concluding that the level of ordinary skill in the art was best determined by the references of record).

C. Claim Construction

We apply the claim construction standard articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). *See Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board*, 83 Fed. Reg. 51,340, 51,358 (Oct. 11, 2018) (amending 37 C.F.R. § 42.100(b) effective November 13, 2018) (now codified at 37 C.F.R. § 42.100(b) (2019)). Under *Phillips*, claim terms are afforded “their ordinary and customary meaning.” *Phillips*, 415 F.3d at 1312. “[T]he ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention.” *Id.* at 1313. Only terms that are in controversy need to be construed, and only to the extent necessary to resolve the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

Petitioner proposes that the “terms of claims 1–3, 7–13, and 16–20 should be given their plain and ordinary meaning,” and does not propose any claim constructions for any particular claim terms. Pet. 21.

Patent Owner argues that, for purposes of its Response, “Patent Owner believes that the terms of the claims at issue should be given their plain and ordinary meaning, including the term ‘applying a weight factor to each condition metric’ of claim 1, which Patent Owner requests that the Board construe.” PO Resp. 3. Patent Owner argues that “one weight factor is applied to the first condition metric, a second weight factor is applied to the second condition metric, and so on.” *Id.* (citing Ex. 1001, 21:4–20). Patent Owner argues that Petitioner “ignores the claim word ‘each’ in its analysis by effectively construing it to mean that a single weight factor can

be applied to all of the condition metrics as a whole” and in essence “construes the term to mean ‘applying a weight factor to the condition metrics.’” *Id.* at 3–4 (citing Pet. 35–36).

Petitioner replies that Patent Owner’s proposed construction “essentially rewrites claim 1 to recite ‘determining a series of condition metrics of [each of] the at least one railroad tie.’” Reply 17. Petitioner argues that the plain language of claim 1 “does not preclude determining a series of condition metrics for multiple ties (e.g., a series of condition metrics for a set of railroad ties).” *Id.*

On the full record now before us, we determine it is not necessary to construe any claim term expressly to resolve the parties’ dispute. *Vivid Techs., Inc.*, 200 F.3d at 803 (“Only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.”); *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (applying *Vivid Techs.* in the context of an *inter partes* review).

D. Prior Art

i. Villar (Ex. 1036)

Villar is titled “System and Method for Inspecting Railroad Track.” Ex. 1036, code (54). Figures 1 and 2 of Villar are reproduced below:

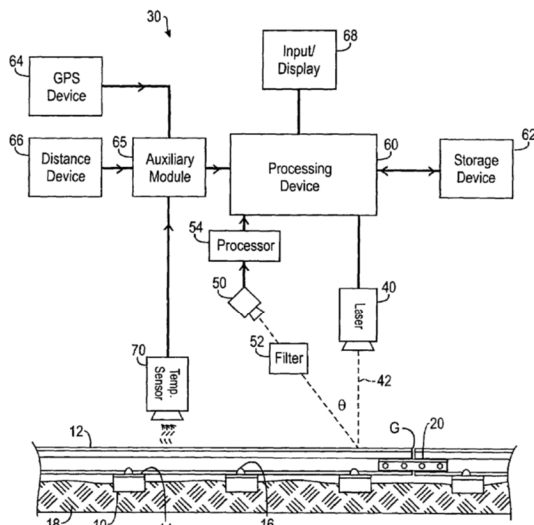


FIG. 1

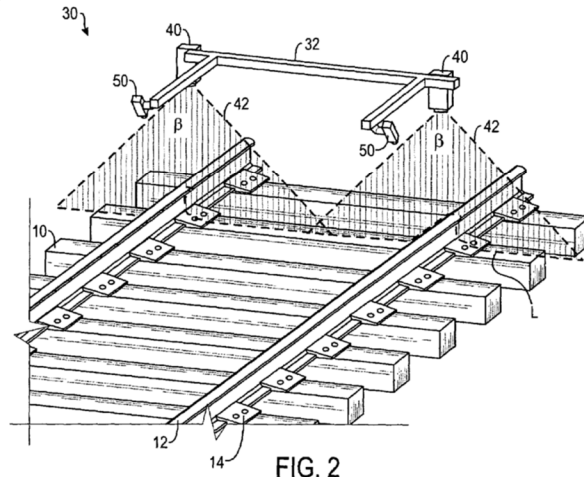


FIG. 2

Figures 1 and 2 show systems for inspecting railroad tracks. *Id.* at 3:24–28. Villar discloses an “inspection system 30 [that] is used to survey the track bed of a railroad track” that “includes a light generator such as a laser 40 [and] a device for receiving light reflected from the area to be inspected such as a camera 50.” *Id.* at 3:29–34. The inspection system captures the reflected light as an image and “sends the captured image to the processing device 60 for processing and analysis.” *Id.* at 3:48–51. The processing and analysis of the captured image allows the inspection system to identify various crosstie features, e.g., “the spacing between crossties” (*id.* at 7:55–56) and “edges of the crosstie contour” to calculate the distance between edges “to estimate the width W2 of the crosstie 10” (*id.* at 9:57–61). Furthermore, “defects in the crossties 10 can be determined from the image data,” e.g., “cracks, splits, or breaks in the ties.” *Id.* at 9:30–31, 9:38–39.

ii. *Haas (Ex. 1037)*

Haas is a published patent application titled “Method and System of Rail Component Detection Using Vision Technology.” Ex. 1037, code (54).

Haas describes “using machine vision technology for more efficient, effective and objective inspections” which “helps lower maintenance cost and improve track capacity.” *Id.* ¶ 25. In particular, Haas describes a “system of automatic railroad track inspection” that captures “videos 110 [of a track] using multiple cameras” and uses “image and video analytics 114” to detect important rail components “including tie plate 116, spike 118, spike hole 118, anchor 120, joint bar and joint bar bolt 122.” *Id.* ¶ 27. Haas’s system involves “comparing the configuration of the rail components to safety requirements for the rail components” (*id.* ¶ 3) and “applying knowledge from federal regulations or domain experts” (*id.* ¶ 37). Haas also provides for:

- 1) monitoring of spiking and anchor patterns; 2) detection of spikes whose heads are raised above the tie plate by more than one inch, as well as spikes that are deadheads; 3) detection of displaced anchors that have moved more than a half inch away from the tie; and 4) detection of any missing bolts, as well as missing nuts and washers, from rail joint bars.

Id. ¶ 25.

iii. *Uzarski (Ex. 1038)*

Uzarski is titled “Development of Condition Indexes for Low Volume Railroad Track.” Ex. 1038, 4.⁸ Uzarski describes condition indexes that “were designed to provide an objective and quantitative means for facility condition assessment” (*id.* at 24), e.g., for “component groups of rail, joints, and fastenings; wooden cross ties and switch ties” (*id.* at 17). The condition indexes have a numerical scale that “ranges from 0 to 100” and “is divided

⁸ We refer to the page numbers appended to Exhibit 1038, rather than the page numbers included in certain portions of the original text of the Exhibit.

into seven condition categories,” e.g., the range of 85–100 corresponds to “Excellent” condition, and the range of 70–85 corresponds to “Very Good” condition. *Id.* at 24.

To calculate the condition indexes, a “weighted deduct-density model” is used to “translate track inspection information . . . to condition indexes.” *Id.* at 33. In particular, the weighted deduct-density model calculates an index “by summing the appropriate individual component group distress types over their applicable severity and density levels through the use of appropriate weighting factors.” *Id.* at 34; *see id.* Fig. 7.

iv. *Velten (Ex. 1041)*

Velten is titled “Application of a Brightness-Adapted Edge Detector for Real-Time Railroad Tie Detection in Video Frames.” Ex. 1041, 6.⁹ Velten describes “real-time image processing” for railroad “tie detection for automated railway inspection.” *Id.* In particular, Velten describes “the application of an edge detection algorithm” for “[a]utomated fault detection . . . limited to the detection of splits or full breaks which look like wider splits” on railroad ties. *Id.*

v. *Kanade (Ex. 1010)*

Kanade is titled “Three-Dimensional Machine Vision.” Ex. 1010, 2.¹⁰ Kanade describes vision systems “developed for an automatic inspection task,” in particular, “a 3D assembly robot vision system.” *Id.* at 546, 557. Kanade describes that “two-dimensional shape-recognition techniques can

⁹ We refer to the page numbers appended to Exhibit 1041, rather than the page numbers included in certain portions of the original text of the Exhibit.

¹⁰ We refer to the page numbers appended to Exhibit 1010, rather than the page numbers included in certain portions of the original text of the Exhibit.

be applied to recognize [a] part and to detect its rotation angle” in 3D space. *Id.* at 562; *see id.* at 558.

E. Prior Art Status of the References

A challenge in an *inter partes* review can be raised “only on the basis of prior art consisting patents or printed publications.” 35 U.S.C. § 311(b). To qualify as a printed publication, “a reference ‘must have been sufficiently accessible to the public interested in the art.’” *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1348 (Fed. Cir. 2016) (quoting *In re Cronyn*, 890 F.2d 1158, 1160 (Fed. Cir. 1989)). “Because there are many ways in which a reference may be disseminated to the interested public, ‘public accessibility’ has been called the touchstone in determining whether a reference constitutes a ‘printed publication’” under 35 U.S.C. § 102. *Id.* (quoting *In re Hall*, 781 F.2d 897, 898–99 (Fed. Cir. 1986)). “A reference will be considered publicly accessible if it was ‘disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it.’” *Id.* (quoting *Kyocera Wireless Corp. v. Int’l Trade Comm’n*, 545 F.3d 1340, 1350 (Fed. Cir. 2008)).

The Board recently clarified in a precedential opinion that “the petition must identify, with particularity, evidence sufficient to establish a reasonable likelihood that the reference was publicly accessible before the critical date of the challenged patent and therefore that there is a reasonable likelihood that it qualifies as a printed publication,” at the institution stage. *Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-01039, Paper 29 at 13 (PTAB December 20, 2019) (precedential). The Petition asserted that “the earliest purported effective filing date of challenged claims 1–3, 7–13,

and 16–20 is March 12, 2013” and that all the relied-upon references are prior art. Pet. 20, 5–7. We determined, at the institution stage, that Petitioner had made the requisite showing. Dec. 10–14. The same evidence from Petitioner regarding public accessibility is before us on this complete record. *See, e.g.*, Exs. 1010, 1038, 1041, 1045.

Patent Owner contends that “Petitioner fails to show that Uzarski, Velten, and Kanade are prior art,” and, accordingly, Petitioner has failed to “establish that its publications are prior art printed publications.” PO Resp. 9. Patent Owner addresses each of these references in turn in its arguments (*id.* at 9–17), and we do the same, below.

i. Uzarski

Uzarski, titled “Development of Condition Indexes for Low Volume Railroad Track,” describes the work of the author and the U.S. Army Corps of Engineers Construction Engineering Research Laboratories in developing these indexes. Ex. 1038, 4. Petitioner submits, with Uzarski, a “Declaration of Rachel J. Watters on Authentication of Publication.” *Id.* at 1. Ms. Watters, a librarian at the University of Wisconsin library system, provides an affidavit stating that, based on her knowledge, Uzarski “was received by Wendt Library, University of Wisconsin-Madison Libraries on February 11, 1994,” and “catalogued and available to library patrons within a few days or at most 2 to 3 weeks after February 11, 1994.” *Id.* at 2.

Patent Owner argues that the declaration of Ms. Watters “does not provide sufficient evidence that (1) Uzarski has been disseminated or (2) that Uzarski has been otherwise made available” (PO Resp. 10–11) because (1) it contains “mere speculation, not evidence, regarding library procedures during the relevant period Uzarski was allegedly published” (*id.* at 11); (2) it

“is devoid of any discussion of how a POSITA could locate Uzarski prior to the critical date by exercising reasonable diligence” (*id.*); and (3) it “fails to address whether any member of the public ever accessed [] Uzarski before the critical date” (*id.* at 13).

Petitioner replies that Ms. Watters’s statements concerning library procedures are not speculative, but “based on her personal experience and knowledge as a University of Wisconsin librarian.” Reply 1. Petitioner further replies that Patent Owner’s cited cases, such as *In re Cronyn*, 890 F.2d 1158 (Fed. Cir. 1989), fail to support Patent Owner’s assertion that Uzarski is not prior art, because unlike Uzarski, the relevant prior art in *Cronyn* was an “undergraduate thesis organized by student names and not generally indexed or cataloged.” Reply 2–3.

As far as indicia on its face, Uzarski has a date of “July 1993” (Ex. 1038, 3, 4), a date stamp of December 7, 1993 (*id.* at 4), an ISBN Number of 89075655969A (*id.* at 3), a library date stamp stating “UW-Madison Wendt Library Feb 11 1994 U.S. Depository Copy Do Not Discard” (*id.*), and a Report Documentation Page, Form OMB No. 0704-0188, with a July 1993 “Report Date” (*id.* at 8). The Report Documentation Page further provides in its “Supplementary Notes” that “Copies are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161,” and in its “Distribution/Availability Statement” that it is “Approved for public release; distribution is unlimited.” *Id.* These statements emphasize the lack of restrictions on accessibility of Uzarski. *Id.* Our findings regarding Uzarski’s facial indicia align with the guidance provided in *Hulu*, in which a date stamp and a declaration contributed to the totality of evidence relevant to public availability. *See*

Hulu, Paper 29 at 9–11, 17–19 (discussing the case-by-case analysis turning on particular circumstances, including the nature of the reference (distinguishing a thesis from a journal article) and the indicia of public accessibility appearing on the face of the reference). Significantly, the facts here include “the indicia on the face of a reference, such as printed dates and stamps,” that are considered as part of the totality of the evidence. *Id.* at 17.

Additionally, by providing the declaration of Ms. Watters, Petitioner has taken further steps to provide testimony that Uzarski was catalogued, shelved, and indexed before the critical date, and made available such that persons of ordinary skill in the art, exercising reasonable diligence, could have located it. *Id.* at 1–2. Ms. Watters, a librarian with the University of Wisconsin-Madison since 1998, provides details regarding her professional background leading to her current position as Director of Wisconsin TechSearch within the University of Wisconsin-Madison. Ex. 1038, 1. She testifies that, based on her knowledge, Uzarski “was received by Wendt Library, University of Wisconsin-Madison Libraries on February 11, 1994.” *Id.* at 2. She further testifies that, based on the information in Uzarski, “it is clear that the microfiche was received by the library on or before February 11, 1994, catalogued and available to library patrons within a few days or at most 2 to 3 weeks after February 11, 1994.” *Id.* The declaration concludes with an affidavit that Ms. Watters is aware that false statements are punishable by fine or imprisonment or both. *Id.*; see 37 C.F.R. § 1.68; 28 U.S.C. § 1746. We have reviewed the testimony of Ms. Watters supporting Uzarski’s public accessibility as of the critical date, and find that Ms. Watters provides credible testimony regarding the receipt of Uzarski by the University of Wisconsin-Madison Library and the cataloging and

availability of Uzarski. On this complete record, we are persuaded that the indicia on Uzarski and the support provided by the Watters declaration demonstrate sufficiently that Uzarski was publicly accessible as of the critical date.

ii. Velten

Velten is an excerpt from the proceedings of the 1999 IEEE International Conference on Acoustics, Speech, and Signal Processing. Ex. 1041, 4. Petitioner submits, with Velten, a Declaration of Pamela Stansbury, an employee of the Cornell University Library since 1982. *Id.* at 1. Ms. Stansbury states that Velten was “cataloged and publicly available at the Engineering Library, in its public stacks, shelved by its Library of Congress classification system number no later than May 26, 1999” based on “the date stamp inside the volume, and my knowledge of the Library’s standard procedures relevant to date stamping, cataloging, and shelving items.” *Id.*

Patent Owner argues that the “only evidence in the record that Velten was publicly accessible prior to the critical date” is the declaration of Ms. Stansbury, which Patent Owner criticizes as “containing conclusory opinions.” PO Resp. 13–14. Patent Owner also argues that Ms. Stansbury never explains the standard procedures referenced in her declaration, nor how they support her opinions. *Id.* at 14. Patent Owner further argues that Petitioner “failed to establish sufficient details as to how one of skill in the art could have located Velten with a reasonable search” and that “Ms. Stansbury’s declaration does not address whether any member of the public ever accessed the book before the critical date.” *Id.* at 16.

As far as indicia on its face, Velten has a date stamp stating “Engineering Library May 26 1999 Cornell University” (Ex. 1041, 3), a legend stating that the conference took place on March 15–19, 1999 (*id.* at 4), an ISBN Number of 3 1924 085 251 076 (*id.* at 3), a Library Catalog Number (*id.* at 5), extensive publication data including an IEEE Catalog Number and several additional ISBN Numbers (*id.*), a statement regarding “Copyright and Reprint Permission: Abstracting is permitted with credit to the source,” along with information about obtaining other copying, reprint, or republication from the IEEE Copyrights Manager (*id.*), and a copyright date of 1999 (*id.* at 5, 6). *See Hulu*, Paper 29 at 9–11, 17–19.

Additionally, Petitioner has taken further steps to provide testimony that Velten was catalogued, shelved, and indexed before the critical date, and made available such that persons of ordinary skill in the art, exercising reasonable diligence, could have located it. *Id.* at 1–2. Ms. Stansbury, a librarian since 1982 with the Cornell University Library, provides details regarding her professional background leading to her current position as Administrative Supervisor in the Original Cataloging Unit. Ex. 1041, 1. She testifies that, based on her knowledge, Velten was “cataloged and publicly available at the Engineering Library, in its public stacks, shelved by its Library of Congress classification system number no later than May 26, 1999.” *Id.* She further testifies that “based on the date stamp inside the volume, and my knowledge of the Library’s standard procedures relevant to date stamping, cataloging, and shelving items,” she has not seen any indication that Velten would have been an exception to the Library’s standard practice, and that “any member of the public could have located this item by searching our catalog by subject matter, author, or title.” *Id.*

The declaration concludes with an affidavit that Ms. Stansbury is aware that false statements are punishable by fine or imprisonment, or both. *Id.*; 37 C.F.R. § 1.68; 28 U.S.C. § 1746. In our evaluation, Ms. Stansbury provides credible testimony regarding the receipt of Velten by the Cornell University Library and the cataloging and availability of Velten.

Patent Owner relies on a number of cases to support its argument that multiple PTAB panels “have rejected declarations by Ms. Stansbury with substantially similar wording to Exhibit 1041 for containing conclusory opinions.” PO Resp. 14. We have reviewed those cases as well as Ms. Stansbury’s declaration in this proceeding, and find this proceeding’s declaration more thorough than the other declarations and sufficient in its own right. *See* Reply 3 (“Ms. Stansbury’s declaration includes additional statements *not* present in the referenced declarations” in Patent Owner’s cited cases). Moreover, we agree that the standard is public accessibility, not access, and thus Petitioner is not required to show that any member of the public actually accessed the reference, only that a member of the public could have accessed it. Reply 4–5; *Samsung Elecs. Co. v. Infobridge Pte. Ltd.*, 929 F.3d 1363, 1374 (Fed. Cir. 2019). We, therefore, credit the testimony of Ms. Stansbury supporting Velten’s public accessibility as of the critical date. On this complete record, we are persuaded that the indicia on Velten, and the support provided by the Stansbury declaration, demonstrate sufficiently that Velten was publicly accessible as of the critical date.

iii. Kanade

Kanade is a book titled “Three-Dimensional Machine Vision,” published by Kluwer Academic Publishers. Ex. 1010, 2. Petitioner submits, with Kanade, a Declaration of Rosalina Delgado-Jones, Assistant Business

Enterprises Officer in the Office of Business Enterprises of the Library of Congress. *Id.* at 1. Ms. Delgado-Jones certifies that Kanade is in the collections of the Library of Congress, and further certifies that Kanade “is marked with a Library of Congress Cataloging-In-Publication stamp that bears the date March 23, 1987.” *Id.* The seal of the Library of Congress is affixed to Ms. Delgado-Jones’s declaration. *Id.* Petitioner also submits a declaration of Ms. Pamela Stansbury, substantially similar to Ms. Stansbury’s declaration for Velten in this proceeding, stating that Kanade was “cataloged and publicly available at the Engineering Library, in its public stacks, shelved by its Library of Congress classification system number no later than November 11, 1987” based on “the date stamp inside the volume, and my knowledge of the Library’s standard procedures relevant to date stamping, cataloging, and shelving items.” Ex. 1045, 1.

Patent Owner argues that the declaration of Ms. Stansbury contains “the same fatal errors as Stansbury Ex. 1041 discussed above.” PO Resp. 16. Patent Owner faults the declaration of Ms. Delgado-Jones for not discussing “the entire Kanade article.” *Id.*

Kanade, on its face, has a copyright date of “1987 by Kluwer Academic Publishers” (Ex. 1010, 7), a stamp stating “Library of Congress 5 Mar 23 1987 Copy __ CIP” (*id.*), publication data (*id.*), a Library of Congress library stamp (*id.* at 3), a Library Catalog Number (*id.* at 7), and additional cataloging notations with the date 1987 (*id.*). There is also a check-out card indicating that Kanade was in fact checked out on multiple occasions between 1987 and 2002 (Ex. 1045, 8). *See Hulu*, Paper 29 at 9–11, 17–19.

Additionally, Petitioner has taken further steps to provide testimony that Kanade was catalogued, shelved, and indexed before the critical date, and made available such that persons of ordinary skill in the art, exercising reasonable diligence, could have located it. Ex. 1010, 1; Ex. 1045. The Stansbury declaration for Kanade is substantially similar to the Stansbury declaration for Velten. *Compare* Ex. 1045, *with* Ex. 1041, 1–2. For the same reasons given above, which address Patent Owner’s objections to the Stansbury declarations regarding Velten, we determine that Ms. Stansbury provides credible testimony regarding the receipt of Kanade by the Cornell University Library and the cataloging and availability of Kanade. Ms. Delgado-Jones certifies that the Library of Congress contains a copy of Kanade, and the reproduced pages in the record “are a true representation from that work.” Ex. 1010, 1. Ms. Delgado-Jones further testifies that the work is marked with a Library of Congress stamp bearing the date March 23, 1987. *Id.* The testimony of Ms. Stansbury and of Ms. Delgado-Jones credibly supports Petitioner’s assertions of Kanade’s public accessibility as of the critical date. *Id.* We are persuaded that the indicia on Kanade itself, and the support provided by the Stansbury and Delgado-Jones declarations, demonstrate sufficiently that Kanade was publicly accessible as of the critical date.

Therefore, on this complete record, Petitioner provides evidence establishing the public accessibility of Uzarski, Velten, and Kanade as of a date prior to the critical date.

F. Asserted Obviousness Over Villar, Haas, and Uzarski (Ground 1)

Petitioner asserts that claims 1–3, 7, 8, 11–13, and 16–20 of the '956 patent are unpatentable as obvious over Villar, Haas, and Uzarski under 35 U.S.C. § 103. Pet. 22–56.

i. Claim 1 - Petitioner's Arguments

Petitioner alleges that the combination of Villar, Haas, and Uzarski teaches:

1[pre] “A system for inspecting railroad ties, comprising:” (*id.* at 22 (citing Ex. 1036, 3:22–28, 10:34–36, 11:34–36, 12:18–20, Figs. 1, 2));

[a] “a. a rail vehicle, configured for moving along a railroad track in a travel direction;” (*id.* at 23 (citing Ex. 1036, 3:53–61, 11:40–42));

[b] “b. a light generator, attached to the rail vehicle, oriented to project a beam of light across the railroad track while moving thereon;” (*id.* (citing Ex. 1036, 3:29–30, 3:44–49, 3:53–57, 4:9–32, 10:37–39, 11:44–46));

[c] “c. an optical receiver, attached to the rail vehicle, oriented to receive at least a portion of the beam of light reflected from the railroad track and configured to generate image data representative of a profile of at least a portion of the railroad track; and” (*id.* at 23–24 (citing Ex. 1036, 3:30–32, 10:40–44, 3:53–57, 3:29–32, 4:9–14, 4:43–52, 5:36–39, 4:55–58, 5:36–39));

[d] “d. a processor, configured to analyze the image data by applying one or more algorithms configured to:” (*id.* at 25 (citing Ex. 1036, 3:33, 4:65–67, 5:7–14, 8:13–24, 8:61–9:4, 5:15–31));

[e] “i. find boundaries of at least one railroad tie in the railroad track; and” (*id.* at 25–29 (citing Ex. 1036, *passim*)); and

[f] “ii. determine the condition of the at least one railroad tie by:
a. determining a series of condition metrics of the at least one railroad tie;
b. applying a weight factor to each condition metric; and c. computing a condition grade of the at least one railroad tie based on the weighted condition metrics” (*id.* at 29–38 (citing Ex. 1037 ¶¶ 2, 25, 27, 29, 36, 37, 41, Figs. 1–7; Ex. 1038, 16, 18–19, 31–36, 40–41, 56–57)).

Petitioner argues that Villar discloses every limitation except “determining the condition of the railroad tie by: (1) determining a series of condition metrics of the at least one railroad tie; (2) applying a weight factor to each condition metric; and (3) computing a condition grade of the at least one railroad tie based on the weighted condition metrics.” Pet. 30.

However, according to Dr. Papanikolopoulos, “it was well-known to one of ordinary skill in the art at the relevant time to determine the condition of railroad ties in this manner, as evidenced, e.g., by *Haas* (Ex-1037) and *Uzarski* (Ex-1038).” *Id.* (citing Ex. 1004 ¶ 58).

Petitioner states that a person having ordinary skill in the art would have been motivated to combine Villar, Haas, and Uzarski

because *Uzarski* provides an ‘unbiased and reputable’ TCI [tie condition index] assessment method to help railroad track maintenance managers routinely (and uniformly) perform tasks, such as assessing current track conditions, predicting future track conditions, establishing track deterioration rates, determining and prioritizing current and long range M&R [maintenance and repair] reports, formulating budgets, and measuring the effectiveness of M&R, as taught by *Uzarski*, 16. And, one of ordinary skill in the art would have known to look to *Uzarski*’s TCI assessment method because it is a specific example of government regulations referenced by Haas as providing pertinent information related to assessing the condition of rail components.

Pet. 37 (citing Ex. 1004 ¶ 70).

ii. Claim 1 - Patent Owner's Arguments

a. Manual and Machine Vision

Patent Owner argues that one of ordinary skill in the art would not have combined a reference concerning a manual method with a reference concerning machine vision. PO Resp. 17 (citing Ex. 2001 ¶¶ 37–39). More particularly, Patent Owner argues, one of ordinary skill in the art would not have combined Uzarski's manual method with Villar's and/or Haas's machine vision systems. *Id.* at 19–25 (citing Ex. 2001 ¶¶ 40–46).

According to Dr. Bovik, there is a “vast chasm between a manual method and an automated method especially where, as here, the automated method uses machine vision,” and “it is not trivial or obvious to write an algorithm to implement a manual method.” *Id.* at 22 (citing Ex. 2001 ¶ 43). Patent Owner further argues that one of ordinary skill in the art “would not have combined the TCI indexes and weighted model of Uzarski with the automated machine vision inspection system of Villar because the underlying basis is the subjective judgement—the grading—by human inspectors.” *Id.* at 23 (citing Ex. 2001 ¶45). The Petition also “provides no proof that Uzarski's manual inspection methodology is capable of being combined with the automated inspection systems in Villar and/or Haas,” according to Patent Owner. PO Resp. 24. More particularly, Patent Owner argues that the “Petition fails to show how the visual inspection method using track inspectors disclosed in Uzarski is capable of being physically integrated into the automated inspection systems of Villar and/or Haas.” *Id.*

Petitioner disputes that it would be generally “difficult, time-consuming, or require special expertise” to implement the method of Uzarski

into the system of Villar. Reply 8. Petitioner also argues that the Board has discretion to “ignore conclusory opinions without scrutiny.” *Id.* Petitioner asserts that Dr. Bovik’s testimony is not only conclusory but also incorrect in view of evidence demonstrating that automating manual inspection tasks was known in the art even before 2004. *Id.* (citing, *inter alia*, Ex. 1010, 545–546, 73, 107, 248–250, 361, 406; Ex. 1007, 5; Ex. 1012, 15; Ex. 1014, 18; Ex. 1018, 9; Ex. 1026, 2; Ex. 1019, 6; Ex. 1021, 3; Ex. 1047, 4; Ex. 1036, 1:66–2:6).

Having reviewed the evidence and testimony before us, we determine that it would have been within the level of ordinary skill in the art to automate the task of inspecting tie condition. For one, Villar itself “automates manual inspection tasks.” *Id.* (citing Ex. 1036, 1:66–2:6). Petitioner provides evidence that Villar and others were using known software and other tools to automate defect-measuring tasks in the art. *Id.* at 9–10 (citing Pet. 14–15; Ex. 1036, 1:66–2:6; Ex. 1019, 3, 6; Ex. 1023, 16–19; Ex. 1012, 19–20, Ex. 1004 ¶¶ 32–33). Petitioner’s expert also attests, with supporting evidence, that the challenged patent as well as “other sheet-of-light range imaging sensor technology would have been well-known and readily available to a person of ordinary skill in the art by 2004.” Ex. 1004 ¶¶ 32–33; Pet. 14–15.

Even taking into account Patent Owner’s allegations of difficulty, amount of time required, or special expertise required, which are based largely on Dr. Bovik’s assertions but little other evidence (*see, e.g.*, Ex. 2001 ¶¶ 37–46), Petitioner has provided sufficient evidence and testimony to demonstrate that it would not be beyond the skill of one in the art to combine the art as proposed and accomplish the tasks described in the challenged

claims. Reply 9–10; *see also Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006) (a “given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine”).

Petitioner also argues that Patent Owner “provides no credible reason why a POSITA would have been unable to implement Villar’s automated vision system with Uzarski’s tie condition index (‘TCI’ []) weighted deduct-density model” in Uzarski’s Equation 2, “including the underlying subjective ratings used to define and determine the distress types (T), severity (S), and density (D) levels, and deduct weighting values.”

Reply 10. As interpreted by Petitioner, Uzarski’s TCI index incorporates “subjective rating opinions of various track problems” to provide a meaningful “unbiased and reputable (i.e. objective)” crosstie condition assessment model. *Id.* at 11. The language of Uzarski relied upon by Petitioner indicates that, once in Equation 2 form, Uzarski’s model is able to be applied objectively to assess railroad track conditions. *Id.* at 15 (“Uzarski’s approach is like GREX’s Aurora system, which implements objective tie grading models based on the subjective tie grading attributes and concerns provided by its customers” (citing Ex. 1054, 18; Ex. 1053, 54–55; Ex. 1052, 38–39; Ex. 1051, 2–3; Ex. 1048, 44:5–19, 53:7–54:10, 43:22–44:2, 79:17–82:6)). Based on Petitioner’s arguments and evidence, we find it is both reasonable and persuasive that one of ordinary skill would have been able to program a system such as Villar’s to apply an objective model like Uzarski’s.

Petitioner also replies that the “Petition does not propose bodily incorporating Uzarski’s visual manual inspection of crossties to Villar,” but

rather, that “the combined teachings of Villar and Uzarski would have suggested to a POSITA to implement Villar’s automated inspection system with a tie condition assessment method, as taught by Uzarski.” Reply 13 (citing Pet. 37–38 (citing Ex. 1038, 16, 18–19)).

Bodily incorporation is not the standard for an obviousness analysis. *See In re Mouttet*, 686 F.3d 1322, 1332–33 (Fed. Cir. 2012); *see also MCM Portfolio LLC v. Hewlett-Packard Co.*, 812 F.3d 1284, 1294 (Fed. Cir. 2015) (the “test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference” (citation omitted)). Petitioner’s proposed combination relies on Uzarski for “government regulations related to the development of condition indexes for railroad track components, including crossties,” and for its assessment method including “(1) determining a series of condition metrics for crossties; (2) applying a weight factor to each condition metric; and (3) computing a condition grade for the railroad tie based on the weighted condition metrics.” Pet. 33–34. Petitioner’s proposed combination does not, in our view, require the ordinarily skilled artisan to bodily incorporate the various systems and processes of Uzarski into Villar.

b. Teaching Away

Patent Owner argues that Villar teaches away from combination with Uzarski. PO Resp. 25–28. Villar, Patent Owner argues, considers manual inspection problematic, because the “process of visual inspection is very time consuming” (*id.* at 25 (citing Ex. 1036, 1:45–46)), and to “overcome the problem of visual inspection, Villar discloses a laser/camera line optical scanning and analysis system that can automatically identify tie defects and grade the ties” (*id.* at 26 (citing Ex. 1036, 2:14–31)). This contrasts with

Uzarski’s “manual visual inspection method” (*id.* (citing Ex. 1038, 4, 17, 42, 88). Patent Owner argues that the automatic inspection system of Villar was invented “to eliminate the need for manual visual inspection, like that employed in Uzarski.” *Id.* at 26 (citing Ex. 2001 ¶ 49).

Petitioner replies that “Villar does not teach away from implementing a tie condition assessment method,” but “rather encourages it.” Reply 12–13. Regarding Patent Owner’s argument that Villar was intended to “eliminate the need for manual visual inspection” (*id.* at 13 (citing PO Resp. 26)), Petitioner argues that, instead, “Villar appreciates the need to regularly inspect and grade track components,” and that “Villar *concedes* that automating manual inspection tasks in 2004 was well-known.” *Id.* at 13–14 (citing Ex. 1036, 1:45–52, 1:66–2:9). Petitioner also notes that Uzarski itself “appreciates using both manual and automatic inspection methods and states that its indexes ‘may work very well for trackage subjected to high traffic volumes and speed,’ where automated systems were commonly used.” *Id.* at 14 (citing Ex. 1038, 18–19, 30).

A reference does not teach away “if it merely expresses a general preference for an alternative invention but does not ‘criticize, discredit, or otherwise discourage’ investigation into the invention claimed.” *Polaris Indus., Inc. v. Artic Cat, Inc.*, 882 F.3d 1056, 1069 (Fed. Cir. 2018) (quoting *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004) (a reference teaches away if it criticizes, discredits, or otherwise discourages the claimed solution)). We are not directed to any portion of Villar that discredits or discourages incorporation of a stepwise assessment method such as the one disclosed in Uzarski. As Petitioner notes, Villar encourages implementation of tie condition assessment methods and automating manual inspection

tasks, and Uzarski itself acknowledges the existence of both manual and automatic inspection methods, stating that its indexes “may work very well for trackage subjected to high traffic volumes and speed,” where automated systems were commonly used. Reply 14 (citing Ex. 1038, 18–19, 30). We agree that using Villar’s inspection system to grade the inspected crossties’ condition, as taught by Uzarski, would “simply be an extension of Villar’s own teachings,” and that Villar does not teach away. *Id.*

c. Motivation to Combine

Patent Owner also argues that the “Petition fails to demonstrate that a POSITA would have a sufficient reason to combine Villar with the other references to achieve the claimed inventions with a reasonable expectation of success.” PO Resp. 28–33. More particularly, Patent Owner faults Petitioner for not providing a motivation to combine Haas with Villar (*id.* at 28–30) and for not providing a reason to combine Villar with Haas and Uzarski (*id.* at 30–33).

Regarding Patent Owner’s arguments directed to motivation to combine Haas and Villar, we understand that Petitioner’s position is based on a combination of three references—Villar, Haas, and Uzarski—rather than just two references—Haas and Villar. Thus, Patent Owner’s arguments directed to motivation to combine only two of these three references do not consider the proposed combination of all three references. Because Petitioner does not, as Patent Owner argues, “suggest[] that the combination of Villar and Haas alone could possibly create one of the claimed combinations” (PO Resp. 29), the alleged absence of reasons to combine Haas alone with Villar alone is not critical to our analysis.

Regarding Patent Owner’s arguments directed to the combination of Villar, Haas, and Uzarski, Patent Owner argues that there is no teaching by Uzarski that its “condition indexes would be ‘unbiased and repeatable’ for automated machine vision,” and thus, one of ordinary skill in the art “would not have expected that Uzarski’s methodology was capable of being implemented into Villar’s machine vision system.” PO Resp. 32 (citing Ex. 2001 ¶ 46). Patent Owner also argues that one of ordinary skill in the art would not combine Villar with Uzarski and Haas because Uzarski does not teach or suggest “that any of its contents are ‘government regulations’” and, thus, Uzarski is not “a specific example of government regulations referenced by Haas” as argued by Petitioner. *Id.* at 32–33 (citing Ex. 2001 ¶ 55).

Petitioner reiterates that “it would have been obvious to a POSITA at the relevant time to implement Villar’s automated track inspection machine vision system’s processing device to determine the condition grade of ties via a tie condition assessment method, as taught by Uzarski” because “Uzarski’s ‘unbiased and reputable’ tie condition assessment method would help track maintenance managers routinely (and uniformly) assess current and predicting future track conditions, establish track deterioration rates, and determine and prioritize current and long-range maintenance and repair reports.” Reply 6–7 (citing Pet. 37–38). Petitioner also reiterates that Uzarski “provides a specific example of government regulations referenced by Haas,” and Uzarski “further discusses visual and automated track inspection systems used by the railroad industry—like Villar’s and Haas’s systems.” *Id.* at 7 (citing Pet. 37–38).

Regarding Patent Owner’s argument that Uzarski is not itself a “government regulation” (PO Resp. 32–33), Petitioner argues that “Uzarski’s tie condition assessment method” is a “specific example of government regulations referenced by Haas.” Reply 21. Petitioner also argues that both Uzarski and Haas recognize that their “assessment methods are suitable for application to both mission readiness (military) track assessment tasks and for profit (commercial) by individual railroad companies to maintain track health.” *Id.* at 21, 23. We are persuaded that Uzarski’s disclosure of government-specific indexes, and its discussion of the development of these indexes by U.S. Army Construction Engineering Research Laboratories in cooperation with the University of Illinois (Ex. 1038, 9), together with Haas’s reference to “government regulations,” sufficiently underpins Petitioner’s reasons to combine the two. Pet. 33–38 (citing Ex. 1038, 9, 16–19, 31–36, 40–41, 56–57; Ex. 1037 ¶¶ 2, 29, 37; Ex. 1004 ¶ 70); *see also* Ex. 1038, 8, Abstract (stating that Uzarski describes development of the indexes and a “separate, follow-on report (USA ERL Technical Report FM-93/14, July 1993) provides track inspectors with a standard reference for identifying track dis-tresses and calculating condition indexes”). Whether or not Uzarski is a government regulation *per se* is not fatal to the proposed combination, when the government regulations discussed and disclosed therein are known to one of ordinary skill in the art, and when Uzarski provides other reasons to combine with Villar and Haas. *See, e.g.*, Tr. 15:7–11 (stating that “even if Uzarski wasn’t a codified regulation it’s still the type of report and guidelines that if you’re looking through Haas and Haas – that you would consider looking at if you were concerned about inspecting rail components.”). Even so, Villar, Haas, and

Uzarski are ultimately combinable as part of Petitioner’s three-reference combination for reasons not having to do solely with “government regulations.” Pet. 37–38; Tr. 16:5–8 (“without even getting into whether it’s a regulation or not, one would have looked to Uzarski because he is providing information about why you would want to adopt his tie condition grading index”).

Petitioner and its declarant provide ample reasons that one of ordinary skill in the art would have been motivated to employ Villar’s processor to use Uzarski’s method, and ample reasons that one of ordinary skill in the art also would have known to look to Haas to determine what was “well-known to one of ordinary skill in the art at the relevant time to determine the condition of railroad ties,” and to identify and use the particular regulations referenced in Uzarski. Pet. 30 (citing Ex. 1004 ¶ 58), 37–38 (citing Ex. 1004 ¶ 70); *see also* Reply 6–12; Ex. 1004 ¶¶ 70–71; Ex. 1038, 18–20. On this complete record, and for the reasons provided by Petitioner and discussed above, we determine that Petitioner provides adequate reasoning to combine the three references in the manner proposed in the Petition with a reasonable expectation of success.

d. Elements [d] and [f]

Patent Owner argues that neither Uzarski, nor Haas, nor the combination of Uzarski and Haas disclose elements [d] and [f] of claim 1. PO Resp. 33–48. More particularly, Patent Owner argues that Uzarski “does not disclose a processor configured in the manner mandated by elements [d] and [f]” of claim 1, for three reasons: (1) Uzarski does not disclose “determining a series of condition metrics of the at least one railroad tie” as recited in element 1[f] (*id.* at 34–35); (2) Uzarski does not employ a

“processor” as recited in element 1[d] to implement its system of grading ties (*id.* at 38); and (3) Uzarski does not disclose at least “applying a weight factor to each condition metric” recited in element 1[f] (*id.* at 40). Finally, Patent Owner argues that Haas does not “disclose a processor configured in the manner mandated by elements [d] and [f]” (*id.* at 41), and that the combination of Haas and Uzarski does not disclose or suggest elements [d] and [f] (*id.* at 42–48).

In response to Patent Owner’s first argument, Petitioner replies that Uzarski does disclose “determining a series of condition metrics of the at least one railroad tie” as recited in element 1[f], because claim 1 is directed to “the at least one railroad tie,” and Uzarski discloses determining a condition metric for at least one railroad tie. Reply 17–23. First, Petitioner argues, Uzarski discloses claim 1’s “determining a series of condition metrics of the at least one railroad tie,” because the plain language of claim 1 “does not preclude determining a series of condition metrics for multiple ties (e.g., a series of condition metrics for a set of railroad ties).” *Id.* at 17. Petitioner also argues that even if the claim were read to require “more than one condition metric for each crosstie, Uzarski still discloses it” with its determination of “a series of condition metrics—distress type, severity level, and distress amount—for its tie condition index assessment method.” *Id.* at 18 (citing Pet. 34–35; Ex. 1038, 33, 56–57).

Uzarski’s Equation 2 is reproduced below:

$$RJCI, TCI, \text{ or } BSCI = C - \sum_{i=1}^p \sum_{j=1}^{m_i} a(T_i, S_j, D_{ij})F(t,d) \quad [\text{Eq 2}]$$

where

- C = Constant equal to 100 for this application
- a() = Deduct weighting value depending on distress type T_i , severity level S_j , and distress density D_{ij}
- i = Counter for distress types
- j = Counter for severity levels
- p = Total number of distress types for component group under consideration
- m_i = Number of severity levels for the i^{th} distress type
- $F(t,d)$ = Adjustment factor for multiple distresses that vary with total summed deduct value, t, and number of individual deducts over an established minimum value, d.

Equation 2 accounts for a distress type (T), a severity level (S), and distress density (D), all subject to a deduct weighting value (a). Ex. 1038, 34.

Uzarski discloses distress types T1 through T8, with T1 indicating a “Single Defective Tie” and T8 indicating an “Improperly Positioned Tie.” *Id.* at 56–57. Both of these factors, by their plain language, concern the condition of an individual railroad tie. *Id.*; see also Ex. 1049, 57:11–17 (stating that “skew angle of a tie,” i.e. improper positioning of a tie, can be a factor when determining the condition of a tie). Moreover, T1 can be further broken down into severity levels low (L) and medium (M), and T8 can be broken down into severity levels low (L), medium (M), and high (H), thereby providing additional metrics relating to individual crossties. Ex. 1038, 57–58. Thus, it appears from our review of Uzarski that “determining a series of condition metrics of the at least one railroad tie” is disclosed, whether the claim language is interpreted as determining a series of condition metrics for one railroad tie or a series of conditions metrics for multiple railroad ties.

In response to Patent Owner’s second argument, Petitioner replies that “attacking Uzarski individually and ignoring its combination with Villar and Haas” misapplies the legal standard for obviousness when based on a combination of references. Reply 8. We agree that Patent Owner’s assertions regarding Uzarski alone, namely, that Uzarski does not employ a

“processor” as recited in element 1[d] to implement its system of grading ties, are not tenable when Petitioner’s obviousness argument does not rely on Uzarski for the processor limitation. Petitioner relies on a combination of three references, and therefore, attacking Uzarski individually for not having a processor is further untenable. *See In re Keller*, 642 F.2d 413, 426 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986) (non-obviousness cannot be established by attacking references individually where the obviousness argument is based a combination of references).

In response to Patent Owner’s third argument, Petitioner argues that Uzarski discloses claim 1’s “applying a weight factor to each condition metric,” because the record and the claim’s plain language do not support Patent Owner’s construction that “applying a weight factor to each condition metric” requires applying a “different” weight factor to each “individual” condition metric. *Id.* at 20. Although Patent Owner relies on one example from the ’956 patent Specification in which “a unique weight factor” is “applied to each variable” (PO Resp. 40–41; Ex. 1001, 21:10–17), this example in the Specification is just “one embodiment” (*id.* at 21:10) and “other mathematical scoring methods and formulas can also be used” (*id.* at 21:19–20). *See also* Tr. 34:14–35:12 (“there’s nothing in the claim language expressly prohibiting” the weight factor from being the same and applied to each condition metric, and “nothing explicit like that in the specification”). A non-limiting, exemplary embodiment in a specification does not mean that the claim language should be read as importing and requiring that one embodiment. *Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 906 (Fed. Cir. 2004) (only when “the patentee has demonstrated a clear intention to limit the claim scope using ‘words or expressions of

manifest exclusion or restriction” is the scope of a claim properly restricted to that of a disclosed embodiment). Because we need not read the limitation “applying a weight factor to each condition metric” as requiring application of a different weight factor to each individual condition metric, we accept Petitioner’s argument that Uzarski’s application of weight factor “a” discloses this limitation of claim 1. Pet. 35 (Uzarski “includes applying a weight factor (i.e., ‘a()’) to each of the condition metrics—i.e., the distress type (T), severity (S), and density or amount (D)”).

e. Additional Arguments

In response to Patent Owner’s final arguments, Petitioner argues that Villar in combination with Haas and Uzarski render obvious claim limitations 1[d] and 1[f], because the “Petition relies on Villar, not Haas, for claim 1[d]’s processor, and Uzarski, not Haas,” for the condition metric. Reply 21. We agree that Petitioner’s combination relies on Villar for the processor limitation and Uzarski for the condition metric limitations. Because Petitioner relies on Villar, rather than Uzarski or Haas, to disclose the processor required in element 1[d] (Pet. 25), Patent Owner’s attempts to discredit Petitioner’s argument with respect to element 1[d] by arguing that Haas and Uzarski do not disclose a processor are misdirected. Regarding element 1[f], we are persuaded by Petitioner’s mapping of the respective elements of Villar, Uzarski, and Haas to the challenged claim limitations. *Id.* at 29–38. Petitioner supports this mapping with extensive discussion of the references themselves, as supported by the testimony of Dr. Papanikolopoulos. *Id.* (citing Ex. 1004 ¶¶ 58–70). As we have found above, Petitioner adequately demonstrates that Villar discloses the processor limitation and Uzarski discloses the condition metric limitation, and

Petitioner also provides well-supported and persuasive reasoning for combining the three relied-upon references in the manner proposed. Accordingly, Patent Owner's arguments regarding Haas's alleged lack of processor and regarding the alleged failure of a Haas-Uzarski combination to disclose or suggest elements [d] and [f] are inapposite in view of the actual arguments presented in the Petition.

On this record, we are persuaded by Petitioner's mapping of the disputed elements of claim 1 to the elements of Villar, Haas, and Uzarski, and by Petitioner's arguments supporting reasons to combine the three references with a reasonable expectation of success.

iii. Claims 8 and 17

Petitioner argues that the combination of Villar, Haas, and Uzarski renders obvious claim 8. Pet. 42–45. Specifically, regarding element [d] of claim 8, which requires “computing a condition grade for the at least one railroad tie based on a weighted summation of the condition metrics,” Petitioner argues that, as “discussed in claim 1[f], *Villar, Haas, and Uzarski* render obvious these limitations of claim 8, and thus also claim 8.” *Id.* at 45 (citing Ex. 1004 ¶ 90).

Petitioner further argues that the combination of Villar, Haas, and Uzarski renders obvious claim 17. Pet. 50–54. Petitioner characterizes element [c] of claim 17 as requiring “analyzing the 3-D profile via a computer processor to determine a set of condition metrics representing each railroad tie in the set of railroad ties,” and “computing a condition grade for each railroad tie based on a weighted summation of the condition metrics.” *Id.* at 53. Petitioner argues that “as discussed in claim 1[f], *Villar* in combination with *Haas* and *Uzarski* does” disclose element 17[c], and

“*Villar, Haas, and Uzarski* thus render obvious these limitations of claim 17.” *Id.* (citing Ex. 1004 ¶ 106).

Patent Owner argues that the Petition is deficient regarding element [d] of claim 8, because “the Petition and Dr. Papanikolopoulos rely on its reasoning why *Villar, Haas, and Uzarski* purportedly disclose element [f] of claim 1.” PO Resp. 49 (citing Ex. 2001 ¶ 102). Patent Owner further argues that “the language of those two elements is not identical” because “claim 8 recites ‘computing a condition grade for the at least one railroad tie based on a weighted summation of the condition metrics’” and claim 1 “does not recite ‘a weighted summation.’” *Id.* at 50.

Patent Owner similarly argues, regarding element [c] of claim 17, that the Petition is deficient because it “relies entirely on its analysis of element [f] of claim 1,” but “the language of those two elements is not identical.” PO Resp. 55. Rather, Petitioner argues, claim 1 “does not recite ‘a weighted summation’” as in element 17[c], but instead recites “applying a weight factor to each condition metric.” *Id.* at 55–56.

Petitioner replies that there is no improper incorporation by reference, as argued by Patent Owner, because “Petitioner merely references paragraphs from the same document, not external sources.” Reply 23. Petitioner also argues that Patent Owner “provides no substantive explanation or evidence supporting why the arguments presented with respect to claims 8 and 17 framed from the analysis set forth with respect to claim 1 are inapplicable.” *Id.*

We do not view Petitioner’s reference to its arguments regarding claim 1[f] as improper incorporation by reference, because Petitioner is not incorporating arguments or evidence from another document. *See* 37 C.F.R.

§ 42.6(a)(3) (“Arguments must not be incorporated by reference from one document into another document.”). Furthermore, in reviewing Petitioner’s arguments regarding claim 1[f], Petitioner appears to address the very problem Patent Owner raises, namely, the issue of weighted summation.

Petitioner argues:

Uzarski’s TCI assessment method includes applying a weight factor (i.e., “a()”) to each of the condition metrics—i.e., the distress type (T), severity (S), and density or amount (D)—“summing the appropriate individual component group distress types over their applicable severity and density levels through the use of appropriate weighting factors.”

Pet. 35 (emphasis added). As shown in Uzarski’s Equation 2, relied upon for Petitioner’s arguments concerning claim 1[f] as well as claim 8[d] and claim 17[c], there appears to be at least one weighted summation (Σ as applied to a()). Ex. 1038, 34; *see also* Ex. 1004 ¶ 68. Although Petitioner ideally would have included these arguments in the section of the Petition addressing claim 8[d] and claim 17[c], Petitioner’s weighted summation arguments are in the Petition and sufficiently apparent to support Petitioner’s burden with respect to claim 8[d] and 17[c].

iv. Claim 12

Petitioner argues that the combination of Villar, Haas, and Uzarski renders obvious claim 12. Pet. 46–48. Specifically, regarding the portion of claim 12 that requires “creating a tie replacement plan that is based upon the location of each railroad tie,” Petitioner argues that Haas discloses creating a tie replacement plan based upon the location. *Id.* (citing Ex. 1004 ¶¶ 94–95; Ex. 1037 ¶¶ 25, 27–29, 36, 38, 40–41, 43, Figs. 1–7).

Patent Owner argues Petitioner “fails to show a reasonable likelihood that claim 12 is unpatentable over Villar, Haas, and Uzarski.” PO Resp. 51. According to Patent Owner, Petitioner admits that “*Villar* does not disclose creating a tie replacement plan based upon the location,” and “erroneously contends that Haas ‘does’ disclose creating such a plan.” *Id.* Patent Owner argues that what Haas does, i.e., “sending exemption information and positioning data to a server for ‘maintenance planning purposes,’ is not even vaguely the same as ‘creating a tie replacement plan’ as recited by claim 12. *Id.* at 51–52. Patent Owner reiterates that “sending information to a service is not the same as, and does not mean that, the information is being used to create a tie replacement plan that is based upon the location of each railroad tie.” *Id.* at 54 (citing Ex. 2001 ¶ 107).

Petitioner replies that Patent Owner

provides no credible reason why Haas’s disclosure of determining at least one crosstie’s condition, severity, and location pursuant to a tiered maintenance timeline for repairing detected rail component problems such that crossties with more severe condition grades are addressed/repared “immediately,” for safety, while those with acceptable condition grades can alternatively be addressed, e.g., “soon,” “during the next inspection,” or “during the next scheduled maintenance window or for use during planning,” even if created based on information sent to the server, would not be understood as a “tie replacement plan.”

Reply 24 (citing Ex. 1037, Abstract, ¶¶ 27–29, 36, 40, Figs. 1–7).

We agree that Petitioner’s cited disclosures of Haas appear to disclose a tie replacement plan. Claim 12 requires “creating a tie replacement plan that is based upon the location of each railroad tie,” but the claim places no further requirements to the creation of the tie replacement plan apart from

basing it upon the location of each railroad tie. Petitioner shows adequately that Haas's inspection system 100 includes a data acquisition module 102 that records positioning information 112 (shown in Figure 1 as a box labeled "GPS"). Pet. 46–47. Petitioner also relies on Haas's track condition monitoring module 104 that uses "various image analytics 114 to identify and detect the current condition of the rail components in the image and a defect severity analysis and temporal condition analysis module 106 to determine a severity of the detected problems in the rail components." *Id.* (citing Ex. 1037 ¶¶ 25, 29, 36, 41, Figs. 1–7). Haas then sends this information, including "positioning data," to "server 132 for *maintenance planning purpose*." *Id.* at 48 (emphasis added) (citing Ex. 1037 ¶ 28). Petitioner also indicates that Haas sets forth "a four-level time frame for repairing detected rail component problems: (1) immediately, (2) soon, (3) during the next inspection, or (4) during the next scheduled maintenance window or for use during planning." *Id.* (citing Ex. 1037 ¶ 38). All together, these portions of Haas disclose creating a tie replacement plan, broken down into several levels of urgency, based upon the location of each railroad tie as well as other data collected by Haas.

v. *Remaining Challenged Claims*

We have also considered Petitioner's and Patent Owner's arguments regarding the remainder of the independent and dependent claims challenged under this ground, namely, claims 2, 3, 7, 11, 13, 16, and 18–20, as follows. We note generally that Patent Owner does not present substantive arguments directed to claims 2, 3, 7, 11, 13, 16, and 18–20 discussed below, apart from referring back to its arguments for claims 1, 8, 12, and 17.

a. *Claim 2*

Claim 2 depends from claim 1 and further requires that “the processor is further configured to: a. determine a location of each railroad tie with respect to the railroad track; and b. correlate the tie location with GPS and/or milepost location.” Petitioner argues that “*Villar* and *Haas* disclose claim 2’s additional limitations, and, *Villar*, *Haas*, and *Uzarski* render obvious claim 2.” Pet. 38–39 (relying on Ex. 1036, 6:5–25; 11:18–20; Ex. 1037 ¶¶ 27, 40, 43; Ex. 1004 ¶ 75).

b. Claims 3, 11, and 19

Claim 3 depends from claim 1 and further requires that “the condition metrics include at least one of: tie warpage, tie surface roughness, tie condition, tie entropy, tie heuristics, tie length, tie width, tie skew angle, tie plate cut, differential plate cut, spike height, depth of adzing, broken condition, curvature, tonnage, speed and decay zone.” Petitioner argues that “*Villar*, *Haas*, and *Uzarski* render obvious claim 3,” relying on *Uzarski* to disclose determining a series of tie condition metrics relating to the condition of the tie, “including: (1) the type of distress, (2) severity of distress, and (3) amount or density of distress.” Pet. 40 (citing Ex. 1038, 33–40; Ex. 1004 ¶ 76).

Claim 11 “depends from claim 8 and recites the same limitations as claim 3,” and Petitioner argues that, as “discussed in claim 3, *Uzarski* discloses claim 11’s additional limitation” so that “*Villar*, *Haas*, and *Uzarski* thus render obvious claim 11.” Pet. 46 (citing Ex. 1004 ¶ 91).

Claim 19 “depends from claim 17 and recites the same limitations as claim 11,” and Petitioner argues that, as “discussed in claim 11, *Villar*, *Haas*, and *Uzarski* render obvious claim 19.” Pet. 55 (citing Ex. 1004 ¶ 110).

c. Claims 7 and 16

Claim 7 depends from claim 1 and requires that “the processor is further configured to identify at least one of un-ballasted bridge ties, a fastener type, the start and end of a rail crossing, a switch, switch points, switch ties, switch frogs and joint bars.” Petitioner relies on Haas to disclose that diagnosed rail components “can include, e.g., rails, crossties, spikes, spike holes, clips, tie plates, anchors, *joint bars*, joint bar bolts, nuts and washers.” Pet. 40–41 (emphasis added) (citing Ex. 1037, Abstract, ¶¶ 2, 25, 27, 29, 36, claim 15, Fig. 1). Petitioner further explains that it “would have been obvious to implement *Villar*’s processing device 60 to further identify joint bars and/or nuts and washers when inspecting the railroad track, as taught by *Haas*.” *Id.* at 41 (relying on Ex. 1004 ¶ 78; Ex. 1036, 1:39–2:6). Petitioner argues that “*Villar*, *Haas*, and *Uzarski* thus render obvious claim 7.” *Id.* at 42.

Claim 16 depends from claim 8, and Petitioner argues that it “recites the same limitations as claim 7,” and thus, “*Villar*, *Haas*, and *Uzarski* render obvious the additional limitation of claim 16.” Pet. 49 (citing Ex. 1004 ¶ 98).

d. Claim 13

Claim 13 depends from claim 8 and further comprises “a. determining a location of each railroad tie in the set of railroad ties with respect to a railroad track bed; and b. correlating the tie location with GPS and/or milepost location.” Petitioner argues that “*Villar*’s inspection system 30 includes a GPS device 64 that determines the geographical location of inspected railroad track components, including crossties,” as does Haas. Pet. 49; Ex. 1036, 6:3–14; Ex. 1037 ¶¶ 27, 40, 43. Petitioner also relies on

Villar’s inspection system 30 that “measures the spacing between crossties based on the plurality of image data of multiple ties and determines a geographic location of the image data.” *Id.* (citing Ex. 1036, 2:22–24, 6:20–21, 7:55–8:3, claims 1, 9, 22, 31, 47, 55). Petitioner argues that “*Villar*, *Haas*, and *Uzarski* thus render obvious claim 13.” *Id.*

e. Claim 18

Claim 18 depends from claim 17 and further requires “a. determining locations of ties with respect to the railroad track; b. correlating the tie location with GPS and/or milepost location relative to the railroad track; and c. creating a tie replacement plan that is based upon the GPS and/or milepost location.” Petitioner relies on Villar and Haas to disclose “determining the location of railroad components including ties (claim 18[a.]) and correlating the locations with GPS relative to the railroad track (claim 18[b.]).” Pet. 54. Petitioner refers to its claim 12 discussion to argue that “it would have been obvious to implement *Villar*, *Haas*, and *Uzarski*’s system with *Haas*’ tie replacement plan based on the GPS location of the captured images, as recited by claim 18[c.].” *Id.* (citing Ex. 1004 ¶ 108–109).

f. Claim 20

Claim 20 depends from claim 19 and further comprises “adjusting the condition grade of the tie based upon at least one of the condition metrics.” Petitioner refers to its claim 1[f] arguments and Uzarski’s Equation 2 to argue that Uzarski discloses this limitation. Pet. 55. Petitioner relies on Uzarski’s explanation that from “a rating perspective, it was found that as additional distress types and/or severity levels occurred in the same sample unit, the impact of any given distress on the condition rating became less,” and to account for this in the model, “an adjustment factor must be applied

to the sum of the individual deducts.” *Id.* at 55–56. Petitioner further relies on Dr. Papanikolopoulos’s testimony that “one of ordinary skill in the art would have understood that *Uzarski*’s adjustment factor ‘adjusts the condition grade of the tie.’” *Id.* at 56 (citing Ex. 1004 ¶ 113).

For the same reasons provided above for claims 1, 8, 12, and 17, as well as the arguments and evidence presented by Petitioner, we are persuaded that Petitioner has demonstrated by a preponderance of the evidence that claims 2, 3, 7, 11, 13, 16, and 18–20 are obvious in view of Villar, Haas, and Uzarski. Thus, based on the complete record currently before us, we are persuaded that Petitioner has demonstrated by a preponderance of the evidence that claims 1–3, 7, 8, 11–13, and 16–20 of the ’956 patent are obvious over Villar, Haas, and Uzarski.

G. Asserted Obviousness Over Villar, Haas, Uzarski, Velten, and Kanade (Ground 2)

Petitioner asserts that claims 9 and 10 of the ’956 patent are unpatentable as obvious under 35 U.S.C. § 103 over Villar, Haas, Uzarski, Velten, and Kanade. Pet. 57–61.

Claim 9 depends from claim 8, and further requires a 3-D optical scanning system, and generating a computer-readable image. Ex. 1001, 24:40–44. Petitioner argues that one of ordinary skill in the art would understand “that *Villar*’s inspection system is a ‘3-D’ optical scanning system,” but that Villar does not disclose using processing device 60 to analyze the computer-readable image representative of a profile of the railroad ties. Pet. 57–58 (citing Ex. 1036, 5:44–49, 7:40–50, Figs. 11, 12; Ex. 1004 ¶ 115). It would have been obvious, according to Petitioner, to “identify boundaries of at least one railroad tie in *Villar*’s computer-readable

image, as evidenced by, e.g., *Velten* (Ex-1041) and *Kanade* (Ex-1010).” *Id.* at 58 (citing Ex. 1004 ¶ 117). The motivation to make this modification would be “to further automate tie fault detection in a computer-readable image, as taught by *Velten* and *Kanade*.” *Id.* at 60 (citing Ex. 1004 ¶ 120)).

Claim 10 depends from claim 9 and further requires “a. projecting a beam of light across a railroad track bed that includes the railroad ties; b. receiving light reflected from the railroad ties with a camera and producing a camera signal; and c. generating, from the camera signal, the computer-readable image.” Ex. 1001, 24:45–53. Petitioner argues that Villar’s inspection system 30

(1) projects a beam of light 42 across the railroad track bed that includes railroad ties 10, (2) receives light 42 reflected from the track bed that includes railroad ties with a camera and producing camera image signals based on received light; and (3) generates from the camera image signals, the computer-readable image representative of a profile of the scanned railroad track bed.

Pet. 61 (citing Ex. 1036, 3:7–8, 3:29–32, 3:45–49, 4:9–14, 4:37–58, 5:32–38, 5:44–49, 7:40–50).

Patent Owner, noting that claims 9 and 10 are dependent on claim 8, argues that because “claim 8 is patentable for at least the reasons stated above, claims 9 and 10 are patentable.” PO Resp. 57.

Petitioner replies that, apart from the claim 8 argument, Patent Owner’s only argument against this ground is that “*Kanade* is non-analogous art,” which, according to Petitioner, is incorrect. Reply 25 (citing PO Resp. 7 (a one-paragraph summary of *Kanade* concluding: “As such, *Kanade* is non-analogous art”). Petitioner argues that “*Kanade* and the claims overlap in the broader field of machine vision, and thus, *Kanade* is

reasonably pertinent to the problem of object recognition.” *Id.* (citing *Unwired Planet, LLC v. Google Inc.*, 841 F.3d 995, 1000–1001 (Fed. Cir. 2016)).

Two separate tests define the scope of analogous prior art: “(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 Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004). Neither party makes well-developed arguments regarding whether Kanade meets this two-part test. Applying this two-part test to the evidence before us, we find no discrete arguments that Kanade is from the same field of endeavor, which is characterized by Patent Owner as an “automated inspection system for railroads” (PO Resp. 7), and by the challenged patent as a “system and method for inspecting railroad ties.” Ex. 1001, code (54). We do agree with Petitioner, however, that Kanade, a textbook titled “Three-Dimensional Machine Vision” deals broadly with the field of machine vision. Reply 25; Ex. 1010, 2. More particularly, Kanade “contains an entire section on 3D recognition algorithms” in addition to its broader treatment of machine vision. Ex. 1004 ¶ 119. Kanade’s broad scope and its particular descriptions of 3D imaging are reasonably pertinent to the field of endeavor, which seeks to “automate tie fault detection in a computer-readable image.” Ex. 1004 ¶ 120. Thus, Kanade satisfies the second prong of the test as being “reasonably pertinent to the problem of object recognition.” Reply 25.

Based on the arguments, testimony and evidence before us, we are satisfied Petitioner has demonstrated by a preponderance of the evidence

that claims 9 and 10 are unpatentable as obvious under 35 U.S.C. § 103 over Villar, Haas, Uzarski, Velten, and Kanade.

III. CONTINGENT MOTION TO AMEND

A. Introduction

Having determined that claims 1–3, 7–13, and 16–20 of the ’956 patent are unpatentable, we address Patent Owner’s Contingent Motion to Amend.

B. Legal Standard

In an *inter partes* review, amended claims are not added to a patent as a matter of right; rather, they must be proposed as a part of a motion to amend. 35 U.S.C. § 316(d). The Board must assess the patentability of proposed substitute claims “without placing the burden of persuasion on the patent owner.” *Aqua Prods., Inc. v. Matal*, 872 F.3d 1290, 1328 (Fed. Cir. 2017) (en banc); see *Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 15 at 3–4 (PTAB Feb. 25, 2019) (precedential). Subsequent to the issuance of *Aqua Products*, the Federal Circuit issued a decision in *Bosch Automotive Service Solutions, LLC v. Matal*, 878 F.3d 1027 (Fed. Cir. 2017), as well as a follow-up order amending that decision on rehearing. See *Bosch Auto. Serv. Sols., LLC v. Iancu*, No. 2015-1928 (Fed. Cir. Mar. 15, 2018) (Order on Petition for Panel Rehearing).

In accordance with *Aqua Products*, *Bosch*, and *Lectrosonics*, a patent owner does not bear the burden of persuasion to demonstrate the patentability of the substitute claims presented in the motion to amend. Rather, ordinarily, “the petitioner bears the burden of proving that the proposed amended claims are unpatentable ‘by a preponderance of the evidence.’” *Bosch*, 878 F.3d at 1040 (as amended on rehearing); see

Lectrosonics, Paper 15 at 3–4. In determining whether a petitioner has proven unpatentability of the substitute claims, the Board focuses on “arguments and theories raised by the petitioner in its petition or opposition to the motion to amend.” *Nike, Inc. v. Adidas AG*, 955 F.3d 45, 51 (Fed. Cir. 2020). Where the finding of unpatentability with respect to the proposed amended claims departs materially from grounds or issues addressed by the parties, the parties must ordinarily be provided prior notice and an opportunity to be heard. *Hunting Titan, Inc. v. Dynaenergetics Europe GmbH*, IPR2018-00600, Paper 67, 22 (PTAB July 6, 2020) (precedential) (explaining that “raising a ground of unpatentability for the first time in a final written decision, after the parties have exhausted their ability to submit briefing and argument to the Board, does not provide sufficient notice of, and opportunity to respond to, such a ground”). Thus, the Board determines whether substitute claims are unpatentable by a preponderance of the evidence based on the entirety of the record, including any opposition made by a petitioner.

Notwithstanding the foregoing, a patent owner’s proposed substitute claims must meet the statutory requirements of 35 U.S.C. § 316(d) and the procedural requirements of 37 C.F.R. § 42.121. *Lectrosonics*, Paper 15 at 4–8. Accordingly, a patent owner must demonstrate: (1) the amendment proposes a reasonable number of substitute claims; (2) the proposed claims are supported in the original disclosure (and any earlier filed disclosure for which the benefit of filing date is sought); (3) the amendment responds to a ground of unpatentability involved in the trial; and (4) the amendment does not seek to enlarge the scope of the claims of the patent or introduce new subject matter. *See* 35 U.S.C. § 316(d); 37 C.F.R. § 42.121.

C. Proposed Substitute Claims

Patent Owner proposes contingently substituting claims 30–44 for claims 1–3, 7–13, and 16–20. Mot. Amend 1. Proposed independent substitute claims 30, 34, and 41 are reproduced below, with underlining indicating text added to the claims that Patent Owner proposes to replace.

30. A system for inspecting railroad ties, comprising:

a. a rail vehicle, configured for moving along a railroad track in a travel direction;

b. a light generator, attached to the rail vehicle, oriented to project a beam of light across the railroad track while moving thereon;

c. an optical receiver, attached to the rail vehicle, oriented to receive at least a portion of the beam of light reflected from the railroad track and configured to generate image data representative of a profile of at least a portion of the railroad track; and

d. a processor, configured to analyze the image data by applying one or more algorithms configured to:

i. find boundaries of at least one railroad tie in the railroad track; and

ii. determine the condition of the at least one railroad tie by:

a. determining a series of condition metrics of the at least one railroad tie;

b. applying a unique weight factor to each condition metric; and

c. computing a condition grade of the at least one railroad tie based on the weighted condition metrics.

Mot. Amend 2–3.

34. A method for inspecting railroad ties, comprising:
- a. scanning a set of railroad ties with an optical scanning system to produce image data;
 - b. analyzing the image data using a processor running a machine vision algorithm;
 - c. identifying, via the processor, boundaries of at least one railroad tie in the set of railroad ties;
 - d. determining, via the processor, condition metrics for the at least one railroad tie in the set of railroad ties; and
 - e. computing a condition grade for the at least one railroad tie based on a weighted summation of the condition metrics, wherein the weighted summation of the condition metrics comprises applying a unique weight factor to each of the condition metrics.

Id. at 4–5.

41. A method for grading railroad ties of a railroad track in situ, comprising:
- a. scanning a set of railroad ties with an optical scanning system and generating image signals representing the railroad ties;
 - b. applying, via a computer processor, a machine vision algorithm to the image signals and generating a 3-D profile of the railroad ties that locates tie features;
 - c. analyzing the 3-D profile via a computer processor to determine a set of condition metrics representing each railroad tie in the set of railroad ties; and
 - d. computing a condition grade for each railroad tie based on a weighted summation of the condition metrics;
 - e. determining a location of each railroad tie in the set of railroad ties;
 - f. determining a spacing between railroad ties with a good or bad condition grade; and

g. correlating the condition grade, location, and spacing between ties with good or bad tie condition grades to create a tie replacement plan.

Id. at 7–8.

D. Statutory and Procedural Requirements

A motion to amend may not present substitute claims that introduce new subject matter. 35 U.S.C. § 316(d)(3); 37 C.F.R. § 42.121(a)(2)(ii). New matter is any addition to the claims that lacks sufficient support in the subject patent’s original disclosure. *TurboCare Div. of Demag Delaval Turbomach. Corp. v. Gen. Elec. Co.*, 264 F.3d 1111, 1118 (Fed. Cir. 2001) (“When the applicant adds a claim . . . , the new claims . . . must find support in the original specification.”). The Board requires that a motion to amend set forth written-description support in the originally filed disclosure of the subject patent for each proposed substitute claim and also set forth support in an earlier-filed disclosure for each claim for which a patent owner seeks the benefit of the earlier-filed disclosure’s filing date. *See* 37 C.F.R. § 42.121(b)(1)–(b)(2).

In its Motion to Amend, Patent Owner identifies citations in the original disclosure of the ’956 patent that it asserts provide support for the proposed amendment of each claim. Mot. Amend 10 (citations omitted).

Petitioner contends that proposed substitute claims 30–40 do not comply with the requirement that the proposed claims are supported in the original disclosure, arguing that proposed substitute claims 30–40 are invalid for lacking written description support. *See* Opp. 6–7; *see* 35 U.S.C. § 316(d); 37 C.F.R. § 42.121. Proposed substitute claim 30 recites “applying a unique weight factor to each condition metric.” Mot. Amend 3 (proposed amendment underlined). Petitioner argues the claim fails “to

comply with the written description requirement because the '956 original disclosure fails to show that the inventors invented applying a 'unique' weight factor to each condition metric.” Opp. 6. However, Equation (1) of the original disclosure shows a mathematical formula in which “ w_n represents the unique weight factor that is applied to each variable.” Ex. 1002, 68 (¶ 111); Ex. 1003, 33 (¶ 111). As discussed above, Equation (1) describes a formula that multiplies a particular weight factor uniquely with a particular tie metric. Accordingly, the '956 original disclosure provides adequate written description support for a “unique” weight factor.

Petitioner does not otherwise dispute that proposed substitute claims 30–40 satisfy the requirements that the amendment propose a reasonable number of substitute claims; the amendment respond to a ground of unpatentability involved in the trial; and the amendment does not seek to enlarge the scope of the claims of the patent or introduce new subject matter. *See generally* Opp.; *see* 35 U.S.C. § 316(d); 37 C.F.R. § 42.121. Petitioner also does not dispute that proposed substitute claims 41–44 satisfy the statutory requirements of 35 U.S.C. § 316(d) and the procedural requirements of 37 C.F.R. § 42.121. *See generally* Opp. On this record, we determine that Patent Owner’s Motion to Amend meets the statutory and regulatory requirements under 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121. Because we ultimately find Petitioner has proven unpatentability, we need not analyze these requirements further.

E. Analysis of the Substitute Claims

Petitioner challenges the patentability of claims 30–44 on the grounds that the claims are invalid as indefinite, as lacking written description, and as

obvious over prior art. Opp. 1, 6–7. First, regarding indefiniteness, Petitioner argues that the term “unique” recited in proposed substitute claims 30–40 is indefinite. *Id.* at 1. Second, Petitioner argues that the term “a good or bad condition grade” recited in the proposed substitute claims 41–44 is indefinite. *Id.* at 5. Third, regarding unpatentability over the prior art, Petitioner challenges the patentability of proposed substitute claims 30–40 as obvious over combinations including Villar, Haas, and Uzarski (*id.* at 9–10) as well as over combinations including Villar, Haas, and Nielsen¹¹ (*id.* at 11–19). Finally, Petitioner challenges the patentability of proposed substitute claims 41–44 as obvious over the combination of Villar, Haas, Uzarski, and Palese.¹² *Id.* at 19–25. We address each of these challenges in turn.

i. Indefiniteness of Proposed Substitute Claims 30–40

Proposed substitute claim 30 recites “applying a unique weight factor to each condition metric.” Mot. Amend 3 (proposed amendment underlined). Proposed substitute claim 34 includes a similar amendment. *Id.* at 5. Patent Owner submits that the claim amendment requires that “a different weight factor—*i.e.*, a factor not ‘like’ or ‘equal’ to any other factor—is applied to each variable.” PO Resp. to Opp. 2. Patent Owner further asserts that “unique” “plainly means that the weighting factor is either unique or it is not. In other words, the weighting factor cannot be the same as another weighting factor.” *Id.* at 1. Petitioner argues that the

¹¹ U.S. Pub. No. 2010/0010863 A1, published January 14, 2010 (Ex. 1055).

¹² J. W. Palese *et al.*, *Tie Planning Tools for the Track Inspector*, The American Railway Engineering and Maintenance of Way Association, Track & Structures Annual Conference (1999) (Ex. 1056).

“phrase ‘unique’ is a subjective term of degree” and, thus, is indefinite.
Opp. 1–2.

We are persuaded the claims fail to inform a person of ordinary skill in the art with reasonable certainty the scope of “a unique weight factor.” We perceive an inconsistency between Patent Owner’s definition of “a unique weight factor” and the ’956 patent’s use of “a unique weight factor” as described in Equation (1). Ex. 1001, 21:10–17. Patent Owner asserts that “the ordinary meaning of the word ‘unique’” is “commonly defined as ‘being the only one’ or ‘being without like or equal.’” PO Resp. to Opp. 1. Patent Owner further argues that “applying a unique weight factor to each condition metric” means “the weighting factor cannot be the same as another weighting factor” and “a different weight factor—*i.e.*, a factor not ‘like’ or ‘equal’ to any other factor—is applied to each variable.” *Id.* at 1–2 (emphasis added); *see* Mot. Amend 14. When asked whether a weight factor could be a common value applied to each condition metric (“What prohibits the weight factor from being say, five in each case when applying each condition metric?”), Patent Owner responded “the words each implies that you’re going to have a weight factor for each individual metric. So that gives you some clue that *it’s not going to be the same one*, otherwise it would say applying a weight factor to the condition metric.” Tr. 34:14–21 (emphasis added). That is, Patent Owner’s arguments suggest that “a unique weight factor” cannot have the value of any other weight factor. *See id.*; *see also* PO Resp. to Opp. 1–2.

However, in contrast to Patent Owner’s description, the ’956 patent supports an interpretation in which a weight factor is “unique” to the particular condition metric to which it is applied, but not necessarily a value

different than or unequal to another weight factor. The '956 patent discloses that tie score S_T can be calculated by Equation (1):

$$S_T = \sum (w_n * M_n)$$

“where w_n represents the *unique* weight factor that is applied to each variable, and M_n represents each tie metric that is used.” Ex. 1001, 21:10–17 (emphasis added). Equation (1) does not necessarily require that its unique weight factor variables w_n , e.g., w_1 , w_2 , w_3 , etc., are different factors, *i.e.*, values, from one another. Rather, Equation (1), which multiplies a particular weight factor and a particular tie metric, suggests that a weight factor w_n is unique respective to its corresponding tie metric M_n . For example, w_1 is uniquely applied to M_1 , w_2 is uniquely applied to M_2 , and so forth. Such an application includes instances in which w_1 and w_2 may be the same value, but are still unique to the tie metric that the weight factor is applied to, *i.e.*, M_1 and M_2 respectively. Patent Owner’s asserted interpretation, however, precludes w_1 and w_2 from having the same value (*see* PO Resp. to Opp. 1–4; Tr. 34:14–35:12), and so highlights the uncertainty of the term “unique.” That is, the claim fails to inform a person of ordinary skill in the art with reasonable certainty whether “a unique weight factor” applied to each condition metric is unique in that the weight factor is only applied to its corresponding condition metric, or unique in that it is different than any other weight factor, *i.e.*, there appear to be two plausible interpretations. “As the statutory language of ‘particular[ity]’ and ‘distinct[ness]’ indicates, claims are required to be cast in clear—as opposed to ambiguous, vague, indefinite—terms. It is the claims that notify the public of what is within the protections of the patent, and what is not.” *In re Packard*, 751 F.3d 1307, 1313 (Fed. Cir. 2014); *see also Nautilus v. Biosig Instruments, Inc.*, 572 U.S.

898, 898–899 (2014) (“A patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention.”).

Accordingly, we conclude that proposed substitute claims 30 and 34 are indefinite. Proposed substitute claims 31–33 and 35–40 depend from proposed substitute claims 30 and 34 and, as such, also are indefinite.

ii. Indefiniteness of Proposed Substitute Claims 41–44

Proposed substitute claim 41 recites, in relevant part, “d. computing a condition grade for each railroad tie . . . f. determining a spacing between railroad ties with a good or bad condition grade.” Mot. Amend 7 (proposed amendment underlined). Petitioner argues the Specification of the ’956 patent “fails to provide an objective basis” for one of ordinary skill in the art “to determine whether a tie has a ‘good or bad’ condition grade.” Opp. 5. Patent Owner’s reply does not dispute that determining “a good or bad condition grade” for a railroad tie is subjective. PO Resp. to Opp. 2.

Instead, Patent Owner argues:

No “objective basis” is needed for determining whether a tie’s condition is “good” or “bad.” The point is that condition criteria are applied (regardless of how implemented), and that ties are assigned such a condition grade. It does not matter if anyone else may apply the grades based on different criteria.

Id.

We are persuaded that the claim fails to inform a person of ordinary skill in the art with reasonable certainty of the scope of “a good or bad condition grade.” The ’956 patent itself states that “[i]t is to be appreciated that this grading scale is somewhat arbitrary” in determining whether a tie as

good or bad. Ex. 1001, 21:21–30. Moreover, Petitioner’s expert asserts that “one of ordinary skill in the art would understand the term ‘good or bad’” is “a qualitative and subjective term of degree.” Ex. 1050 ¶ 35; *see* Opp. 5. As such, both the Specification and expert testimony support Petitioner’s assertion that the ’956 patent “fails to provide an objective basis for a one of ordinary skill in the art to determine whether a tie has a ‘good or bad’ condition grade.” Opp. 5–6; Ex. 1050 ¶ 35.

Additionally, as Patent Owner argues, the limitation reciting “f. determining a spacing between railroad ties with a good or bad condition grade” does not recite determining a “good or bad” condition grade, because that limitation determines spacing between ties, rather than determining tie condition. PO Resp. to Opp. 2. However, to the extent that we can locate an antecedent basis for the proposed “good or bad” limitation, the claim also recites “d. computing *a condition grade* of the at least one railroad tie based on the weighted condition metrics.” Ex. 1001, 23:57–58 (emphasis added). Taking limitations d. and f. together, the claim suggests that the condition grade determination includes “a good or bad” determination. As discussed above, the Specification does not provide any basis for the ordinary skilled artisan to objectively determine a “good or bad” condition, and, instead, states that such condition grades are “somewhat arbitrary.” *Id.* at 21:21–30.

Determining the spacing between railroad ties with “a good *or* bad condition grade” (emphasis added) is indefinite for an additional reason: due to the use of “or,” the structure of the limitation makes the conditions for determining spacing unclear. For example, determining the spacing between railroad ties with “a good or bad condition grade” includes any of:

1) determining the spacing between consecutive good railroad ties,

2) determining the spacing between consecutive bad railroad ties, and
3) determining the spacing between good railroad ties and bad railroad ties.
All three interpretations are supported by the claim language, but it is unclear which interpretation is the prevailing one. Furthermore, if the claim includes all three options, then the limitation would be rendered meaningless because the limitation would determine the spacing between any railroad ties in any condition, i.e., good *or* bad, and the spacing between ties would be arbitrarily determined. As such, the claim language, in view of the Specification, fails to inform a person of ordinary skill about the scope of the invention. *See In re Packard*, 751 F.3d at 1313; *see also Nautilus*, 572 U.S. at 898–899.

Accordingly, we conclude that proposed substitute claim 41 is indefinite. Proposed substitute claims 42–44 depend from proposed substitute claim 41 and, as such, are also indefinite.

iii. Obviousness of Proposed Substitute Claims 30–40 over Villar, Haas, and Nielsen

Proposed substitute claim 30 recites “applying a unique weight factor to each condition metric.” Mot. Amend 3 (amendment underlined). Although we conclude that “a unique weight factor” is indefinite, as discussed above, the indefiniteness of the term does not impede our ability to analyze the obviousness of the claim over the combination of Villar, Haas, and Nielsen. Whether “a unique weight factor” is unique and only applied to a respective condition metric, or has a unique value different than another weight factor, we conclude that substitute claim 30 would have been obvious over the combination of Villar, Haas, and Nielsen.

Nielsen is titled “Methods and Apparatus for Quality Assessment of a Field Service Operation Based on Multiple Scoring Categories.”

Ex. 1055, code (54). As Nielsen explains, field service operations are “any operation in which companies dispatch technicians and/or other staff to perform certain activities, for example, installations, services and/or repairs,” e.g., a “locate and marking operation.” *Id.* ¶¶ 5–6. Nielsen is drawn to a “quality assessment system” that “may receive information related to a locate and marking operation,” and that will “automatically assess the quality of the operation.” *Id.* ¶ 64. In one embodiment, Nielsen describes performing an automatic quality assessment by “selecting . . . a weighting factor for each of the plurality of quality assessment criteria, the weighting factor for each quality assessment criterion indicating the relative importance of the quality assessment criterion to each of the other quality assessment criteria.” *Id.* ¶ 30. Nielsen’s weighting factors for each of the plurality of quality assessment criteria are “unique”—both uniquely applied to a respective quality assessment criteria, and unique as having a unique value different than another weight factor, thus, satisfying both interpretations of “unique” discussed above. For example, unique weight factor of “x1” is applied to “Accelerometer data” and a different unique weight factor of “x5” is applied to “Battery strength data.” *Id.* at Table 6.

Petitioner asserts that Nielsen teaches “applying a unique weight factor to each condition metric.” Opp. 15–16. Patent Owner does not dispute that Nielsen teaches “applying a unique weight factor to each condition metric” in performing a quality assessment and, instead, argues that the combination of Villar, Haas, and Nielsen is improper. *See* PO Resp. to Opp. 5–9. In particular, Patent Owner argues Nielsen is not analogous art.

Id. at 6. Patent Owner further argues that “there is absolutely no teaching or suggestion in Haas that there needs to be ‘weighting’ of the alleged ‘tie condition metrics,’” and so “[n]othing in Haas indicates any need for further analysis that would prompt a POSITA to look” to Nielsen. *Id.* at 8.

As discussed above, two separate tests define the scope of analogous prior art: “(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 Bigio*, 381 F.3d at 1325. “A reference is reasonably pertinent if, even though it may be in a different field from that of the inventor’s endeavor, it is one which, because of the matter with which it deals, logically would have commended itself to an inventor’s attention in considering his problem.” *In re Clay*, 966 F.2d 656, 659 (Fed. Cir. 1992).

Nielsen generally relates to “any operation in which companies dispatch technicians and/or other staff to perform certain activities, for example, installations, services and/or repairs,” e.g., a “locate and marking operation.” Ex. 1055 ¶¶ 5–6. Nielsen’s generality indicates that its field of endeavor may overlap with the field of the inventor’s endeavor, which is characterized by Patent Owner as an “automated inspection system for railroads” (PO Resp. 7), and by the challenged patent as a “system and method for inspecting railroad ties.” Ex. 1001, code (54).

Even if Nielsen is in a different field of endeavor, Nielsen is reasonably pertinent to the particular problem with which the invention is concerned. The ’956 patent involves a type of automated quality assessment: “to automatically identify tie defects and grade the ties.”

Ex. 1001, 1:26–29, 14:13–14. Similarly, Nielsen provides “automated quality assessment” solutions. Ex. 1055 ¶¶ 63–64. Petitioner’s expert confirms that Nielsen addresses “optimiz[ing] . . . computed condition grades.” Ex. 1050 ¶ 48. Petitioner’s expert further states that a person of ordinary skill in the art would have understood that Nielsen describes improvements to quality assessments, e.g., “tak[ing] into account the relative importance of one condition metric relative to another when determining the condition grade, as some condition metrics can have a greater predictor of the condition score.” *Id.* ¶ 49 (citing Ex. 1055 ¶¶ 30, 214). Accordingly, because the ’956 patent is concerned with how to perform automatic quality assessments, and a person of ordinary skill in the art would understand that Nielsen provides solutions for automatically assessing quality, the inventor of the ’956 patent would have looked to Nielsen in seeking solutions for providing automated quality assessments. As such, Nielsen is analogous art.

Furthermore, even considering Patent Owner’s arguments that “there is absolutely no teaching or suggestion in Haas that there needs to be ‘weighting’ of the alleged ‘tie condition metrics’” and “[n]othing in Haas indicates any need for further analysis that would prompt a POSITA to look” to Nielsen (PO Resp. to Opp. 8), the rationale Petitioner provides for the combination of Villar, Haas, and Nielsen is reasonable. Patent Owner’s argument appears to demand that some teaching, suggestion, or motivation for the combination be found in the references themselves, but that approach to analyzing the obviousness inquiry has been rejected as too rigid. *KSR Int’l Co.*, 550 U.S. at 415. Instead, obviousness requires “some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *In re Kahn*, 441 F. 3d 977, 988 (Fed. Cir. 2006). In this case,

Petitioner's expert states a person of ordinary skill in the art would have combined Villar, Haas, and Nielsen to apply

a unique weight factor to each of Haas' condition metrics (e.g., moved or broken ties), such that the weight factor applied for each condition metric is based on and indicative of the relative importance of that condition metric (e.g., moved ties) to each of the other condition metrics (e.g., broken ties), and the condition grade is computed based on the weighted condition metrics.

Ex. 1050 ¶ 49. Petitioner's expert explains that the skilled artisan "would have been motivated to make this modification because, as Nielsen explains, it would take into account the relative importance of one condition metric relative to another when determining the condition grade, as some condition metrics can have a greater predictor of the condition score." *Id.* (citing Ex. 1055 ¶¶ 30, 214). Petitioner's expert further explains that the skilled artisan would have been motivated to combine Villar, Haas, and Nielsen in order "to make informed decisions by creating more comprehensive metrics (often with the use of weight factors)." *Id.* As such, improving the calculation of a score, i.e., improving a computed condition grade, rationally supports the combination of Villar, Haas, and Nielsen.

Additionally, proposed substitute claim 34 would have been obvious over the combination of Villar, Haas, and Nielsen, for reasons similar to proposed substitute claim 30. Proposed substitute claim 34 recites, "e. computing a condition grade for the at least one railroad tie based on a weighted summation of the condition metrics, wherein the weighted summation of the condition metrics comprises applying a unique weight factor to each of the condition metrics." Mot. Amend 5 (proposed amendment underlined). Like proposed substitute claim 30, which recites "applying a unique weight factor to each condition metric," proposed

substitute claim 34 similarly recites “applying a unique weight factor to each of the condition metrics.” *Id.* at 3, 5. Patent Owner argues that “substitute claim 34[d] does not recite a weight summation of the condition metrics” and we “should find substitute claim 34[d] patentable for at least this reason.” PO Resp. to Opp. 8–9. Proposed substitute claim 34, however, expressly recites “a weighted summation of the condition metrics.”

Furthermore, Petitioner argues, the combination of Villar, Haas, and Nielsen teaches the proposed amendment in claim 34 reciting “wherein the weighted summation of the condition metrics comprises applying a unique weight factor to each of the condition metrics,” for the same reason as the combination teaches “applying a unique weight factor to each condition metric,” as recited in proposed substitute claim 30. Opp. 16–17. Notably, Petitioner points out that Nielsen teaches “combining the weighted scoring value or grades for all of the quality assessment criteria to generate at least one indication of the quality assessment.” Opp. 16 (citing Ex. 1055 ¶ 30). Thus, proposed substitute claim 34 would have been obvious over the combination of Villar, Haas, and Nielsen for essentially the same reasons as proposed substitute claim 30.

For the foregoing reasons and for the reasons discussed in our unpatentability analysis of claim 1, we conclude that the subject matter of proposed substitute claims 30 and 34 would have been obvious based on the combined teachings of Villar, Haas, and Nielsen.

The proposed substitute dependent claims recite the same subject matter as the original dependent claims but are amended to change their dependency from the proposed substitute independent claims. Therefore, the proposed substitute dependent claims are unpatentable for reasons discussed

above with respect to the proposed substitute independent claims and the original dependent claims. More particularly, proposed substitute dependent claims 31–33 and 35–40, which correspond, respectively, to claims 2, 3, 7, 9–13, and 16, are unpatentable as having been obvious over the combination of Villar, Haas, and Nielsen.

In addition, Petitioner further asserts claims 30–40 are unpatentable over the combination of Villar, Haas, and Uzarski or the combination of Villar, Haas, Uzarski, Velten, and Kanade. Opp. 9–10. Because we already conclude that claims 30–40 are unpatentable over the combination of Villar, Haas, and Nielsen, we need not address the patentability of the claims over the combinations of Villar, Haas, and Uzarski or the combination of Villar, Haas, Uzarski, Velten, and Kanade.

Having considered the full record developed during trial, we deny Patent Owner’s Motion to Amend as to proposed substitute claims 30–40 because they are unpatentable under 35 U.S.C. § 103.

iv. Obviousness of Proposed Substitute Claims 41–44

Proposed substitute claim 41 recites, in part,

e. determining a location of each railroad tie in the set of railroad ties;

f. determining a spacing between railroad ties with a good or bad condition grade; and

g. correlating the condition grade, location, and spacing between ties with good or bad tie condition grades to create a tie replacement plan.

Mot. Amend 7–8 (proposed amendments underlined).

Petitioner contends that the combination of Villar, Haas, Uzarski, and Palese teaches the proposed amendment. Opp. 19–25. Villar, as discussed above, describes an automated railroad track inspection system in which

“defects in [track] crossties 10 can be determined from [captured] image data.” Ex. 1036, 9:30–31. Villar also describes that “the spacing between crossties can be determined from the plurality of image data.” *Id.* at 7:55–56. Palese, titled “Tie Planning Tools for the Track Inspector,” describes “tools . . . to assist [a] tie inspector and planner in making more accurate and optimal decisions concerning crosstie replacement.” Ex. 1056, 6, 9. Specifically, tools “for recording, storing and analyzing tie condition information” and a tool “evaluat[ing] historic tie installation information for forecasting future tie requirements on a macro basis.” *Id.* Among other features, Palese’s tools include a “lateral track strength measurement system [that] can be used to locate clusters of ties not suitable in the lateral direction.” *Id.* at 19. Palese defines a “tie cluster” as “continuous counts of 2 to 10 (or more) bad ties in a row.” *Id.* at 25.

Patent Owner contends that proposed substitute claim 41 is not unpatentable over Villar, Haas, Uzarski, and Palese. PO Resp. to Opp. 9–12. First, Patent Owner argues that “Petitioner fails to identify how Palese qualifies as prior art.” *Id.* at 9–10. Second, Patent Owner argues Palese’s “tools [do] not provide a link to using an ‘automated’ track inspection system.” *Id.* at 11. Third, Patent Owner argues Palese does not teach “a ‘spacing between ties with a good or bad tie condition grades.’” *Id.* at 12. Fourth, Patent Owner argues a person of ordinary skill in the art “would not look to combine Palese with Villar” because “Palese discloses the manual inspection of railroad ties” while “Villar teaches away from the manual inspection of railroad ties.” *Id.* at 10.

Initially, we disagree with Patent Owner that Palese has not been properly established as qualified prior art by Petitioner. PO Resp. to Opp. 9.

Palese is an excerpt from the proceedings of the American Railway Engineering & Maintenance of Way Association 1999 Annual Conferences. Ex. 1056. On its face, Palese displays a 1999 copyright date and indicia that it was produced in connection with conferences held in Baltimore, Maryland from August 29–September 1, 1999 and in Chicago, Illinois from September 12–15, 1999. *Id.* at 1, 6. On Palese’s face is a stamp reading “M.I.T. LIBRARIES RECEIVED” on December 18, 2000. *Id.* at 1. A Declaration of Michael P. Carney, a research analyst at Finnegan, Henderson, Farabow, Garrett & Dunner, LLP, was submitted with Palese, in which Mr. Carney explains the significance of the stamp on Palese’s face. Ex. 1057 ¶ 1. Mr. Carney opines that the “December 18, 2000, date stamp” on the face of Palese “indicates that the MIT Libraries received a published copy of Palese by that date and that it would have been shelved for the public within a few days or weeks after that date.” Ex. 1057 ¶ 14. Further, Mr. Carney asserts that Palese includes a Machine-Readable Cataloging (“MARC”) system record, which includes a date field listing “the first six characters ‘010111’ in ‘YYMMDD’ format, indicating that Palese was first catalogued by the UC Berkley Library on January 11, 2001” and, thus, was “publicly available at least as early as January of 2001.” *Id.* ¶¶ 17–18.

On this complete record, we are persuaded that Petitioner has adequately shown Palese is prior art. Citing the Palese reference and Mr. Carney’s declaration, Petitioner explains that substitute claims 41–44 would have been obvious over Villar, Haas, Uzarski, and Palese because “the creation of a tie replacement plan accounting for the spacing between ties with good or bad condition grades . . . was well-known in the art at the relevant time, as evidenced by, e.g., Palese.” Opp. 19 (citing Ex. 1056;

Ex. 1057) (emphasis added). As such, Petitioner reasonably relies on Mr. Carney's declaration to establish that the teachings of Palese qualify as prior art under 35 U.S.C. § 103. Patent Owner does not otherwise contest that Palese was publicly available and is prior art before the critical date. *See* Opp. 9–10. On this record, we credit the indicia of public accessibility available on the face of the Palese reference, and the testimony of Mr. Carney supporting Palese's public accessibility as of the critical date.

Further, we disagree with Patent Owner that Palese does not teach an “automated” track inspection system. PO Resp. to Opp. 11. Palese's “tools [are] available to railway inspection and maintenance planning personnel to aid in a better understanding of tie degradation and future crosstie requirements.” Ex. 1056, 19; *see id.* at 9. For example, one “class of tools that aid the tie inspector is the lateral track strength measurement system” that “can be used to locate clusters of ties not suitable in the lateral direction.” *Id.* at 19. Palese describes that lateral track strength measuring tools are automated: for example, an exemplary system “applies vertical and lateral loads,” performs “extrapolation of the measured data under load,” and “provides planning software in the form of exception reports, mile-by-mile tie requirements, cluster breaking tie requirements, and a host of other statistics.” *Id.* at 21–22, Fig. 10; *see id.* at 19–21, Fig. 8.

Moreover, Patent Owner's attack on Palese individually does not address the combination of Villar, Haas, Uzarski, and Palese. As discussed above, Villar teaches the automated railroad track inspection system relied upon by Petitioner to make its obviousness arguments. *See* Ex. 1036, 7:22–34, 9:62–10:22. As such, even assuming that Palese does not teach an “automated” railroad track inspection system, the combination of Villar,

Haas, Uzarski, and Palese teaches an automated railroad track inspection system.

We also disagree with Patent Owner’s argument that “Petitioner never contends that Palese determines a ‘spacing between ties with a good or bad tie condition grades.’” PO Resp. to Opp. 12. Petitioner points out that Palese’s system locates “clusters of bad ties” and “ascertains tie condition distribution.” Opp. 22 (citing Ex. 1056, 19–22, 25). Indeed, Palese analyzes a “detailed distribution of ties . . . to provide the user with number of tie clusters.” Ex. 1056, 25. Palese defines “tie clusters” as “continuous counts of 2 to 10 (or more) bad ties in a row.” *Id.* As such, the identification of tie clusters by Palese, as pointed out by Petitioner (Opp. 22; Paper 25, 24:14–20, 25:5–7) determines a spacing between ties with bad conditions—namely, that there is no spacing between bad ties because the bad ties are continuous.

We also disagree with Patent Owner’s argument that Villar and Palese would not have been combined by one of ordinary skill in the art because “Villar teaches away from the manual inspection of railroad ties,” while Palese states that “walking tie inspections are still very important.” PO Resp. to Opp. 10. Like our discussion above regarding the combination of Villar and Uzarski, we are not directed to any portion of Villar that discredits or discourages incorporation of a method for determining tie spacing and tie conditions such as the one disclosed in Palese. *Polaris Indus., Inc.*, 882 F.3d at 1069. Furthermore, although Palese states “walking tie inspections,” i.e., manual inspections, “are still very important,” in context, Palese makes that statement because its system is “limited to testing groups of ties in the lateral plane only.” Ex. 1056, 22. That is, Palese describes that its automated track inspection system is unable to detect

problematic ties in a non-lateral plane, and, so, the reason manual inspections are important is to identify problematic ties in the non-lateral plane. As such, Palese fails to teach or suggest that its manual inspections should not be replaced by automatic tie inspections. Moreover, Patent Owner's argument is based on the improper bodily incorporation of manual, non-lateral inspections. PO Resp. to Opp. 10. The proffered combination does not require the incorporation of manual inspections. Accordingly, neither Villar nor Palese teaches away from their combination. Instead, we agree with Petitioner's expert that a person of ordinary skill in the art would have "been motivated to" combine the references in order "to create an optimized crosstie inspection and maintenance plan to help direct an operator to where and how many ties should be installed." Ex. 1050 ¶ 62. We also agree with Petitioner's expert that a person of ordinary skill in the art would have "been motivated to" combine the references in order to improve "inspection of rail components" because Palese teaches improvements for rail inspections system. *Id.* (citing Ex. 1056, 8–9, 11, 18, 25–28, 31). As discussed above, we agree that implementing the automated track inspection and tie grading system of Villar and Haas and Uzarski to help direct an operator to where and how many ties should be installed pursuant to an optimized tie replacement plan, as taught by Palese, would simply be a predictable extension of Villar's teachings. Opp. 23. For the foregoing reasons and for the reasons discussed in our unpatentability analysis of claim 17, we conclude that the subject matter of proposed substitute claim 41 would have been obvious based on the combined teachings of Villar, Haas, Uzarski, and Palese.

The proposed substitute dependent claims recite the same subject matter as the original dependent claims but are amended to change their dependency from the proposed substitute independent claims. Therefore, the proposed substitute dependent claims are unpatentable for reasons discussed above with respect to the proposed substitute independent claims and the original dependent claims. More particularly, proposed substitute dependent claims 42–44, which correspond, respectively, to claims 18–20, are unpatentable as having been obvious over Villar, Haas, Uzarski, and Palese.

Having considered the full record developed during trial, we deny Patent Owner’s Motion to Amend as to proposed substitute claims 30–44.

IV. CONCLUSION¹³

For the reasons discussed above, we determine Petitioner has proven, by a preponderance of the evidence, that the challenged claims are unpatentable, as summarized in the following table:

Claims	35 U.S.C. §	References/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–3, 7, 8, 11–13, 16– 20	103(a)	Villar, Haas, Uzarski	1–3, 7, 8, 11– 13, 16–20	

¹³ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

Claims	35 U.S.C. §	References/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
9, 10	103(a)	Villar, Haas, Uzarski, Velten, Kanade	9, 10	
Overall Outcome			1–3, 7–13, 16–20	

We also determine that proposed substitute claims 30–44 are unpatentable and deny the motion to amend as to these claims, as summarized in the following table:

Motion to Amend Outcome	Claims
Original Claims Cancelled by Amendment	
Substitute Claims Proposed in the Amendment	30–44
Substitute Claims: Motion to Amend Granted	
Substitute Claims: Motion to Amend Denied	30–44
Substitute Claims: Not Reached	

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner establishes, by a preponderance of the evidence, that claims 1–3, 7–13, and 16–20 of U.S. Patent No. 9,441,956 B2 are unpatentable; and

FURTHER ORDERED that Patent Owner's Contingent Motion to Amend is *denied*; and

FURTHER ORDERED that this is a Final Written Decision; therefore, 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.

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