

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLIED MATERIALS, INC.,
Petitioner,

v.

OCEAN SEMICONDUCTOR LLC,
Patent Owner.

IPR2021-01342 (Patent 6,968,248 B1)
IPR2021-01344 (Patent 6,907,305 B2)

Before MIRIAM L. QUINN, JOHN D. HAMANN, and DAVID COTTA,
Administrative Patent Judges.

QUINN, *Administrative Patent Judge.*

JUDGMENT

Consolidated Final Written Decision
Determining All Challenged Claims Unpatentable
Granting-in-part Petitioner's Motion to Strike
35 U.S.C. § 318(a); 37 C.F.R. §§ 42.20, 42.23(b)

I. INTRODUCTION

We instituted *inter partes* review pursuant to 35 U.S.C. § 314 to review claims 1–22 of U.S. Patent No. 6,968,248 B1 (“the ’248 patent”) and to review claims 1–25 and 33–53 of U.S. Patent No. 6,907,305 B2 (“the ’305 patent”) owned by Ocean Semiconductor LLC (“Patent Owner”). We have jurisdiction under 35 U.S.C. § 6(c). This Consolidated Final Written Decision is entered pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 47.73. For the reasons discussed below, Applied Materials, Inc. (“Petitioner”) has shown by a preponderance of the evidence that all the challenged claims of the ’248 and ’305 patents are unpatentable.

II. CONSOLIDATION OF PROCEEDINGS

The two captioned proceedings (IPR2021-01342¹ and IPR2021-01344²) involve related patents. The 1342 IPR involves the ’248 patent,³ which is a continuation of the ’305 patent,⁴ involved in the 1344 IPR. Both of these patents have a common disclosure. The proceedings have the same asserted prior art, present the same expert testimony, and involve the same threshold issues. For instance, the arguments presented by Patent Owner for both proceedings are identical as they primarily focus on limitations recited in the independent claims, which recite substantively identical subject matter. Given the significant overlap of arguments and evidence across both proceedings, consolidation is appropriate because the Board can more efficiently handle the common issues and evidence, and also remain

¹ Hereinafter referred to as “the 1342 IPR.”

² Hereinafter referred to as “the 1344 IPR.”

³ Filed as Exhibit 1001 in the 1342 IPR.

⁴ Filed as Exhibit 1001 in the 1344 IPR, and as Exhibit 1002 in the 1342 IPR.

IPR2021-01342 (Patent 6,968,248 B1)

IPR2021-01344 (Patent 6,907,305 B2)

consistent across proceedings. Under 35 U.S.C. § 315(d), the Director may determine the manner in which these pending proceedings may proceed, including “providing for stay, transfer, consolidation, or termination of any such matter or proceeding.” *See also* 37 C.F.R. § 42.4(a) (“The Board institutes the trial on behalf of the Director.”). And more specifically, Rule 122(a) specifically authorizes the Board to consolidate multiple proceedings involving the patent that is before the Office. 37 C.F.R. § 42.122(a). Out of an abundance of caution, and because the proceedings do not involve the same patent, the Board inquired whether the parties object to consolidation and neither party raised objections to consolidation of these proceedings. Tr. 33:6–13. Therefore, for a more efficient disposition of these proceedings, we consolidate the 1342 IPR and 1344 IPR for rendering this consolidated Final Written Decision.

III. BACKGROUND

Petitioner filed the 1342 and 1344 petitions requesting *inter partes* review as follows:

(a) in the 1342 IPR, Petitioner requested review of claims 1–22 of the ’248 patent (1342 IPR, Paper 1 (“1342 Pet.”)); and

(b) in the 1344 IPR, Petitioner requested review of claims 1–25, 33–53 of the ’305 patent (1344 IPR, Paper 1 (“1344 Pet.”)).

Patent Owner filed a Preliminary Response in both proceedings, presenting substantially the same arguments. IPR2021-01342, Paper 10; IPR2021-01344, Paper 10. After considering the merits of the Petition and the arguments presented against institution by Patent Owner, we instituted *inter partes* review. 1342 IPR, Paper 17 (“1342 Dec. on Inst.”); 1344 IPR, Paper 17 (“1344 Dec. on Inst.”).

During the trial phase, Patent Owner filed a substantively identical Response in each proceeding. 1342 IPR, Paper 21 (“1342 PO Resp.”); 1344, Paper 21 (“1344 PO Resp.”). Petitioner filed a Reply in each proceeding. 1342 IPR, Paper 30 (“1342 Reply”); 1344 IPR, Paper 30 (“1344 Reply”). Subsequently, Patent Owner filed a Sur-reply in each proceeding. 1342 IPR, Paper 41 (“1342 Sur-reply”); 1344 IPR, Paper 41 (“1344 Sur-reply”).⁵

During trial, Petitioner filed a Motion to Strike seeking exclusion of certain Patent Owner Sur-reply arguments. 1342 IPR, Paper 46; 1344 IPR, Paper 46 (hereinafter referred to as “Motion” or “Mot.” because the Motion is identical in both proceedings). Patent Owner opposes the Motion. 1342 IPR, Paper 49; 1344 IPR, Paper 49 (hereinafter referred to as “Opposition” or “Opp.” because the Opposition is substantively identical in both proceedings). Petitioner filed a reply responding to Patent Owner’s arguments in opposition. 1342 IPR, Paper 53; 1344 IPR, Paper 53 (hereinafter referred to as “Reply to Opposition” or “Reply to Opp.” because the Reply to Opposition is identical in both proceedings).

A single oral argument was held for both captioned proceedings, the transcript of which is filed in the record. 1342 IPR, Paper 60 (“Tr.”) (identical copy filed as Paper 58 in the 1344 IPR).

A. Related Matters

The parties indicate that the ’248 and ’305 patents have been asserted in the following proceedings: *Ocean Semiconductor LLC v. Analog Devices*, No. 1:20-cv-12310 (D. Mass); *Ocean Semiconductor LLC v.*

⁵ These are titled “Amended Sur-reply” because after filing the initial Sur-reply, Patent Owner sought leave to update its brief with citations to the final transcript of the deposition of Dr. Shanfield. Ex. 2044 (dated September 22, 2022). We refer to the Amended Sur-reply throughout this proceeding.

IPR2021-01342 (Patent 6,968,248 B1)

IPR2021-01344 (Patent 6,907,305 B2)

Infineon, No. 1:20-cv-12311 (D. Mass.); *Ocean Semiconductor LLC v. Huawei*, No. 4:20-cv-911 (E.D. Tex.); *Ocean Semiconductor LLC v. MediaTek*, No. 6:20-cv-1210 (W.D. Tex.); *Ocean Semiconductor LLC V. NVIDIA*, No. 6:20-cv-1211 (W.D. Tex.); *Ocean Semiconductor LLC v. NXP*, No. 6:20-cv-1212 (W.D. Tex.); *Ocean Semiconductor LLC v. Renesas*, No. 6:20-cv-1213 (W.D. Tex.); *Ocean Semiconductor LLC v. Silicon Labs*, No. 6:20-cv-1214 (W.D. Tex.); *Ocean Semiconductor LLC v. ST Micro*, No. 6:20-cv-1215 (W.D. Tex.); and *Ocean Semiconductor LLC v. Western Digital*, No. 6:20-cv-1216 (W.D. Tex.). 1342 Pet. 1–2; Paper 5, 2; 1344 Pet. 1–2; Paper 5, 2.

B. The Challenged Patents

The '305 patent issued from U.S. App. No. 10/135,145 (“parent ’145 application”) filed April 30, 2002. 1342 IPR, Ex. 1002 (the '305 patent, which is also filed as Ex. 1001 in the 1344 IPR).⁶ The '248 patent issued from U.S. App. No. 11/151,098 (“’098 application”), which claims priority to the parent '145 application. Ex. 1001 (the '248 patent); Ex. 1002.

1. Prosecution History

During the prosecution of the parent '145 application, the Examiner found all pending claims anticipated or obvious in view of U.S. Patent No. 5,444,632 (“Kline”), which discloses a method and a computer system with a scheduler module in an automated manufacturing environment. 1342 IPR, Ex. 1006, 152–54. In response, the Applicant argued that Kline fails to teach that its wafer specification module is “anything other than an information provider.” Ex. 1006, 164. The Applicant also argued that Kline

⁶ Hereinafter, all citations refer to the papers and exhibits filed in the 1342 IPR, unless stated otherwise.

does not teach the “software scheduling agent” recited in the claims because Kline’s workstation “includes a user and significant hardware components.”

Id. In a subsequent Office rejection, of anticipation by Parad, Applicant argued that Parad did not disclose the “software scheduling agent” for similar reasons—implementation in hardware. *Id.* at 190.

The Examiner maintained the rejection over Parad and responded that the claims as drafted are broad enough to encompass “anybody involve[ed] in scheduling,” and the Specification does not limit the claim to software programming. *Id.* at 204. Applicant argued that “there is no support in Applicant’s specification for the proposition that a scheduling agent represent more than one manufacturing domain entity at any given time or that a scheduling agent be implemented in anything other than software.” *Id.* at 204–205. Applicant further clarified, “there is no support for a definition of the term ‘software scheduling agent’ in which an entity represents, for instance, a whole subsystem comprising large numbers of manufacturing domain entities.” *Id.* at 205. Further, Applicant noted that the word “software” in the claim term itself denotes that the scheduling agent must be implemented as software. *Id.* at 205–206. The Office issued an advisory action rejecting all pending claims. *Id.* at 209. After a notice of appeal and brief from Applicant, the Office issued a Notice of Allowance without providing any reasons. *Id.* at 243–246.

The Applicant filed the '098 application on June 13, 2005, one day before the issuance of the '305 patent, and included 22 claims substantially identical to some claims of the '305 patent. Ex. 1005,⁷ 75–81 (amending claims slightly to add “automatically” to the steps that recite detecting and notifying, as well as adding “integrated, automated” to the term “process flow”). On August 22, 2005, the Examiner issued a Notice of Allowance and the '248 patent issued November 22, 2005. Ex. 1005, 96–97.

2. Overview

The specification of the two patents are identical. Therefore, we discuss the subject matter described therein with respect to the '248 patent.

The '248 patent relates to “scheduling in an automated manufacturing environment.” Ex. 1001, 1:20–21. The '248 patent describes the manufacture of integrated circuits for modern semiconductor devices containing numerous structures or features, typically the size of a few micrometers. *Id.* at 1:38–41. The '248 patent further describes that the fabrication of integrated circuits generally involves processing a number of wafers through a series of fabrication tools, where layers of material are added to, removed from, and/or treated on a semiconducting substrate. *Id.* at 1:41–45. According to the '248 patent, controlling a semiconductor factory (“fab”) that fabricates such integrated circuits is a challenging task, where the fab is a complex environment where numerous parts (typically 40,000 wafers or more) and numerous part types (typically 100 part types or more) are simultaneously being manufactured. *Id.* at 1:65–2:3. As each wafer moves through the fab, it may undergo more than 300 processing steps,

⁷ Exhibit 1005 in the 1342 IPR is the Prosecution History File for the '248 patent.

many of which use the same machines, where a large factory may contain approximately 500 computer-controlled machines to perform this wafer processing. *Id.* at 2:3–8. As described in the '248 patent, routing, scheduling, and tracking material through the fab is a difficult and complicated task, even with the assistance of a computerized factory control system. *Id.* at 2:8–11.

The specification then describes a process flow that fabricates semiconductor devices. *Id.* at 5:5–8. “However, the invention may be applied to other types of manufacturing processes.” *Id.* As such, the lots of wafers are generically referred to as “work pieces.” *Id.* at 5:8–10. Indeed, the specification goes on to describe that the tools and process operations in the manufacturing process “need not necessarily be related to the manufacturing of semiconductor devices in all embodiments.” *Id.* at 5:13–16. In accordance with the desire to explain the invention using semiconductor fabrication terminology, the '248 patent goes on to describe that the process flow includes a portion of a Manufacturing Execution System or “MES.” *Id.* at 5:26–29. An automated MES “enables a user to view and manipulate, to a limited extent, the status of machines or tools, or ‘entities,’ in a manufacturing environment.” *Id.* at 2:27–31. Further, the process flow also includes an Automated Materials Handling System or “AMHS,” which handles the lots of wafers and facilitates their transport from one station to another, as well as other locations in the process flow. *Id.* at 5:26–32.

Figure 3 illustrates an implementation of reactive scheduling of activities of a process flow for a semiconductor fabrication facility and is reproduced below. *Id.* at 4:28–32.

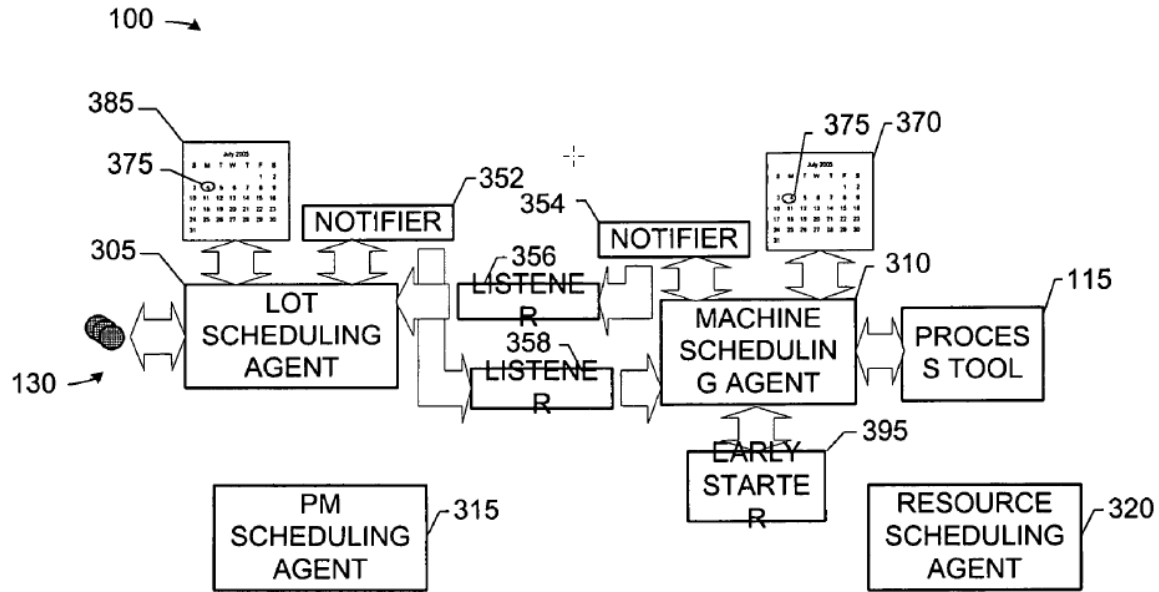


FIG. 3

Figure 3 shows a portion of process flow 100 from a semiconductor fabrication facility, and the manner in which it schedules appointments for the consumption of resources. *Id.* Process flow 100 includes stations 105, each station 105 including computing device 110 communicating with process tool 115. *Id.* at 5:17–19. Process tools 115 process lots 130 of wafers that will eventually become integrated circuit devices, where process tool 115 may be a fabrication tool used to fabricate some portion of the wafers. *Id.* at 5:24–26, 6:43–45.

Each computing device 110 includes software agent 265, where software agents 265, collectively, are responsible for efficiently scheduling and controlling lots 130 of wafers 135 through the fabrication process. *Id.* at 6:24–26, 47–50. Collectively, software agents 265 reactively and proactively schedule activities for each lot 130 for operations on a specific qualified process tool 115. *Id.* at 6:63–7:3. More specifically, the software agents (or scheduling agents) 265 include: Lot Scheduling Agent (“LSA”)

305 that schedules activities on behalf of lots 130; Machine Scheduling Agent (“MSA”) 310 that schedules activities on behalf of process tools 115; PM Scheduling Agent (“PMSA”) 315 that schedules activities on behalf of preventative maintenance (“PMs”) and equipment qualification (“Quals”) (not shown in Figure 3); and Resource Scheduling Agent (“RSA”) that schedules activities on behalf of resources (not shown in Figure 3). *Id.* at 7:20–30. Some of these activities are scheduled reactively (i.e., in response to events occurring in process flow 100). *Id.* at 7:36–37. For example, the ’248 patent describes the process as detecting an occurrence of a predetermined event in the process flow 100; notifying a subscribing software scheduling agent (e.g., LSA 305, MSA 310, PMAS 315, or RSA 320) of the occurrence; and reactively scheduling an action responsive to the detection of the predetermined event. *Id.* at 7:38–46.

C. Illustrative Claims

Of the challenged claims, claims 1 and 14 of the ’248 patent are independent. Each of challenged claims 2–13 and 15–22 depends from claim 1 or 14. Of the challenged claims, claims 1, 12, 19, 33, and 44 of the ’305 patent are independent. Each of challenged claims 2–11, 13–18, 20–25, 34–43, and 45–53 depends from claim 1, 12, 19, 33, or 44. We reproduce below (with certain portions italicized for emphasis) claim 1 of the ’248 patent, followed by claim 1 of the ’305 patent, which are illustrative of the subject matter involved.

Claim 1 of the ’248 patent:

1. A method for scheduling in an automated manufacturing environment, comprising:

automatically detecting an occurrence of a predetermined event in an *integrated, automated* process flow;

automatically notifying a software scheduling agent of the occurrence; and

reactively scheduling an action from the software scheduling agent responsive to the detection of the predetermined event.

Ex. 1001, 30:40–48.

Claim 1 of the '305 patent:

1. A method for scheduling in an automated manufacturing environment, comprising:

detecting an occurrence of a predetermined event in a process flow;

notifying a software scheduling agent of the occurrence; and

reactively scheduling an action from the software scheduling agent responsive to the detection of the predetermined event.

Ex. 1002, 39:52–60.

The italicized language in claim 1 of the '248 patent above reflects the limitations added during the preliminary amendment and the only differences between the two claims. Noting the differences in claim language is important because Patent Owner raises arguments attempting to distinguish the “integrated, automated process flow” from the prior art of record, without regard for the differences in claim language. *See* 1342 PO Resp. 24–25; 1344 PO Resp. 24–25.

D. Asserted Grounds and Testimony of Record

Both captioned proceedings involve the following prior art references:

a) *Schulze*: US 2002/0116083, published August 22, 2002, filed as Exhibit 1007 in the 1342 IPR and as Exhibit 1005 in the 1344 IPR;⁸ and

b) *Gupta*: US 4,888,692, issued December 19, 1989, filed as Exhibit 1008 in the 1342 IPR and as Exhibit 1006 in the 1344 IPR.⁹

Petitioner asserts the following grounds of unpatentability:

Claims Challenged in the 1342 IPR	35 U.S.C. §	References
1–22	103	Schulze, Gupta
Claims Challenged in the 1344 IPR	35 U.S.C. §	References
1–25, 33–53	103	Schulze, Gupta

As for testimony, Petitioner relies on a Declaration of Dr. Stanley Shanfield, filed as Exhibit 1003 in the 1342 IPR (“1342 Shanfield Declaration” or “1342 Shanfield Decl.”) and Exhibit 1002 in the 1344 IPR (“1344 Shanfield Declaration” or “1344 Shanfield Decl.”). The deposition transcript of Dr. Shanfield is filed in the record of both proceedings as Exhibit 2044, dated September 22, 2022 (“Shanfield Depo.”).

Patent Owner relies on a Declaration of Kurt D. Humphrey, filed as Exhibit 2041 in both proceedings. 1342 IPR, Ex. 2041 (“1342 Humphrey Declaration” or “1342 Humphrey Decl.”); 1344 IPR, Ex. 2041 (“1344 Humphrey Declaration” or “1344 Humphrey Decl.”). The deposition of

⁸ For convenience we refer to all citations of Schulze as Exhibit 1007 (or “Schulze” where it makes sense) notwithstanding that the reference has been filed in the 1344 IPR as Exhibit 1005.

⁹ For convenience we refer to all citations of Gupta as Exhibit 1008 (or “Gupta” where it makes sense) notwithstanding that the reference has been filed in the 1344 IPR as Exhibit 1006.

Mr. Humphrey is filed in the 1342 IPR as Exhibit 1046, dated June 22, 2022 and in the 1344 IPR as Exhibit 1044 (“Humphrey Depo.”).

E. Level of Ordinary Skill in the Art

Petitioner contends that a person having ordinary skill in the art “would have at least a B.S. in computer science, mechanical engineering, electrical engineering, or a related field, and three years of experience working with automated manufacturing processes.” 1342 Pet. 17; 1344 Pet. 16. Patent Owner does not dispute this contention “to the extent that it encompasses a degree in materials science and notes that additional education might compensate for less experience, or vice versa.” 1342 PO Resp. 7; 1344 PO Resp. 7. Neither party argues that a particular level of ordinary skill in the art makes a difference in the outcome of the issues presented in these proceedings. We adopt Petitioner’s level of ordinary skill in the art, particularly because, consistent with the challenged patents and the cited prior art, it specifies having knowledge of automated manufacturing processes; we note that this knowledge may be obtained either from three-years of experience or from additional education. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (stating that the 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). We note however, that our analysis regarding obviousness does not depend on whose level of ordinary skill in the art we adopt.

IV. CLAIM CONSTRUCTION ANALYSIS

In *inter partes* review proceedings based on petitions filed on or after November 13, 2018, such as this one, we construe claims using the same claim construction standard that would be used in a civil action under

IPR2021-01342 (Patent 6,968,248 B1)

IPR2021-01344 (Patent 6,907,305 B2)

35 U.S.C. § 282(b), as articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc), and its progeny. *See* 37 C.F.R. § 42.100(b).

Petitioner submits that no claim term needs to be construed, as the prior art relied on in the Petition discloses the subject matter of the challenged claims under any reasonable construction, including their plain meaning. Pet. 16. However, in its Petition, Petitioner asserts that the preamble of the independent claims is not limiting. *See, e.g.*, 1342 Pet. 41 (arguing that the preamble, “a method for scheduling an automated manufacturing environment,” is not limiting because it merely states “a purpose or intended use for the invention”); 1344 Pet. 40. Patent Owner states in its response that “Patent Owner does not presently believe that claim construction is necessary for the Board to determine the patentability of the ’248 patent in light of Schulze and Gupta.” 1342 PO Resp. 7; 1344 PO Resp. 7 (stating identical argument but referring to the ’305 patent).

Patent Owner changed course with its Sur-reply, asserting that the preamble is limiting and stating that Petitioner had the burden to seek a claim construction for the preamble as not being a limitation. 1342 Sur-reply 2; 1344 Sur-reply 2–3. Patent Owner further asserts that an “automated manufacturing environment is one in which multiple machines or resource operations are scheduled simultaneously.” 1342 Sur-reply 3; 1344 Sur-reply 3.

At oral argument, Petitioner argued that the preamble is not limiting and that it “simply informs of what the intent of the claims is to be used for, intended use or purpose.” Tr. 6:13–19. According to Petitioner, it is possible that an MES might be sufficient to satisfy the “automated manufacturing environment” given that they were known to have some automatic features in that they would be able to control tools and follow the

process, but it is not clear what minimum amount of automated manufacturing would be required if the preamble were limiting. *Id.* 7:6–21. For its part, Patent Owner argued at oral argument that the preamble is limiting because the claims do not recite “a method for scheduling compromising [sic],” but rather, the claim specifically recites a method for reactively scheduling in an automated manufacturing process. *Id.* at 13:1–9 (also proffering that by reciting the “integrated, automated process flow,” the claim requires the context of the preamble’s “automated manufacturing environment”). Patent Owner also, for the first time at oral argument, argued that the plain and ordinary meaning of the claim, illuminated by the specification, must take into account the title of the patent and the abstract, both of which mention the “automated manufacturing environment.” *Id.* at 13:22–14:16 (alluding also to the problems in the prior art dealing with MES system and the flow of materials within an automated system).

Other claim construction issues are evident from the parties’ arguments. For instance, buried in the obviousness analysis, as will be discussed in more detailed below, Patent Owner attempts to limit the recited “integrated, automated process flow” to one that requires certain components and that the “software scheduling agents” must reactively schedule in a “dynamic” and “globally reactive” manner.

Accordingly, there are disputes, as to the scope of the claim, which we resolve here.

A. Whether the preamble is limiting

The standard that governs the significance of the “preamble” in claim construction is set forth in *Catalina Marketing Int’l, Inc. v. Coolsavings.com, Inc.*, 289 F.3d 801 (Fed. Cir. 2002). *See* Pet. 41. In

IPR2021-01342 (Patent 6,968,248 B1)

IPR2021-01344 (Patent 6,907,305 B2)

general, a preamble limits the invention if it recites essential structure or steps, or if it is necessary to give life, meaning, and vitality to the claims.

Catalina Marketing, 289 F.3d at 808.

Claims 1 and 14 of the '240 patent and claims 1, 12, 19, 33, and 44 of the '305 patent recite preambles as follows:

Claim No.	Preamble
Claim 1 of '240 patent	a method for scheduling in an automated manufacturing environment, comprising:
Claim 14 of '240 patent	an automated manufacturing environment, comprising:
Claim 1 of '305 patent	a method for scheduling in an automated manufacturing environment, the method comprising:
Claim 12 of '305 patent	a computer-readable, program storage medium encoded with instructions that, when executed by a computer, perform a method for scheduling in an automated manufacturing environment, the method comprising:
Claim 19 of '305 patent	a computing system programmed to perform a method for scheduling in an automated manufacturing environment, the method comprising:
Claim 33 of '305 patent	an automated manufacturing environment, comprising:
Claim 44 of '305 patent	an automated manufacturing environment, comprising:

Review of the above recitations together informs us that there are two permutations of the preamble. The first is where the claim is directed to an apparatus, used in an automated manufacturing environment. The second is where method claims (or computing/program claims) are directed to scheduling in an automated manufacturing environment. Either way, the

body of these claims do not mention further, or grammatically refer back to, the “automated manufacturing environment.” The body of the claims also fails to expressly address any structural significance of the “automated manufacturing environment,” and there is no evidence that the term was a point of distinction over the prior art during prosecution.

Patent Owner’s argument that the preamble is limiting lacks factual and legal support. In the Response, Patent Owner makes a naked assertion that the independent claims recite a “sophisticated ‘automated manufacturing environment’ (preamble)” (among other limitations) and that neither Shulze nor Gupta, alone or in combination, teaches or suggests the mentioned limitations. 1342 PO Resp. 8; 1344 PO Resp. 8 (similar argument, but referring to the “automated manufacturing environment” as “advanced” rather than “sophisticated”). Similarly, in the 1344 IPR, Patent Owner asserts that the independent claims “explicitly refer” to an “automated manufacturing environment,” without explaining why this is a claim limitation even though the term appears only in the preamble of the independent claims. 1344 PO Resp. 24.

Petitioner cites *Arctic Cat Inc. v. GEP Power Prods., Inc.*, 919 F.3d 1320, 1328 (Fed. Cir. 2019), for the proposition that a preamble is not limiting where a patentee defines a structurally complete invention in the body of the claim and the preamble only states a purpose or intended use for the invention. 1342 Reply 2–3; 1344 Reply 2–3. We agree with Petitioner. The body of the apparatus claims defines the structural elements that make up the “automated manufacturing environment.” For instance, claim 14 of the ’248 patent recites an “integrated, automated process flow” and “a computing system” as the main elements comprising the “automated manufacturing environment” of the preamble. Ex. 1001, 32:3–11.

Likewise, claim 33 recites “a process flow” and a “computing system” as the main elements comprising the “automated manufacturing environment” of the preamble. Ex. 1002, 43:43–50. Notably, dependent claim 41, which depends from claim 33, further recites “at least one of a manufacturing execution system and an automated materials handling system.” *Id.* at 44:38–41. In sum, the independent claims recite the required structures and some dependent claims recite further structures in the body of those claim. The “automated manufacturing environment” is merely the “environment” in which these structures are employed to perform the recited “scheduling.”

The method claims are similarly structured. For instance, claim 1 of the '248 patent recites the steps of the method and identifies the structures for performing the recited steps as “integrated, automated process flow” and “software scheduling agent.” Ex. 1001, 30:40–48. The claim again recites the structural elements that are needed to perform the claimed steps. The “automated” part of the preamble is not necessary to define the claimed method given that the step already recites what must happen “automatically” and that the process flow is “automated.” Nor is the “manufacturing environment” necessary for the performance of the method steps. Rather, it specifies the environment in which to perform the method claims.

Patent Owner argues that its expert, Mr. Humphrey, testified that from “a technical perspective, certainly the preambles describe the scope and nature of the claim elements,” and that “to that extent, they are limit[ing].” 1342 Sur-reply 2; 1344 Sur-reply 2. Neither Patent Owner nor Mr. Humphry elaborates further. Although there are situations in which the context of the invention is necessary to give life and meaning to the claims, that situation is not present here. *See Applied Materials, Inc. v. Advanced*

Semiconductor Materials Am., Inc., 98 F.3d 1563, 1572–73 (Fed. Cir. 1996) (addressing a district court’s analysis that determined whether a preamble was limiting given the context of the state of the art at the time of the invention). After analysis of the specification, described below, we conclude that the specification also does not support Patent Owner’s contention that the preamble is limiting as necessary to give context to the claim.

The ’248 patent¹⁰ describes the problems with facilities for manufacturing products, such as semiconductor chips, where the fab is described as a “complex environment.” Ex. 1001, 1:65–2:3; 2:12–26. The manufacturing process used tracking and monitoring at every step and the challenge was to perform regular maintenance and qualification procedures without affecting significantly the manufacturing process itself. *Id.* The specification describes one solution known in the prior art, using an “automated MES” to view and manipulate the status of machines and tools, or “entities,” in “a manufacturing environment.” *Id.* at 2:27–31. But another problem, according to the specification, needed solving, the involvement of a wafer fab technician (“WFT”). *Id.* at 2:45–3:22. The WFTs injected inefficiencies in an otherwise “automated MES” because the scheduling decisions were made when attention and time permitted. *Id.* Shift changes, breaks, days off, etc., also create inefficiencies or machine idle time. *Id.* This method of operation is called “passive” in the

¹⁰ The specification of the ’305 patent is identical to the ’248 patent specification, so the analysis presented here is equally applicable to the ’305 patent claims. Further, when discussing the specification of the challenged patents, citation to the ’248 patent specification alone indicates the content that is presented on both patents.

specification, because the activities in the control system are initiated by the WFT, as opposed to being self-starting or self-initiating. *Id.* at 3:4–7.

This is the extent with which the specification describes the “automated manufacturing environment” of the claims. Though one specific context of the manufacturing is a complex fab of semiconductor chips, the specification specifically warns against limiting the invention to manufacturing of this specific type. *See* Ex. 1001, 5:10–13 (stating that none of the process operations need be related to the manufacture of semiconductor devices). Further, the claims say nothing about how “automated” the facility must be in the “manufacturing environment” other than requiring that certain steps are performed “automatically.” Indeed, from the specification’s description of the problems plaguing the industry, it appears that although automated, an MES could experience undesirable “passive” scheduling caused by the WFTs. Thus, in referring to an automated manufacturing environment in the preamble, the claim is not clear as to the level of automation that would be required by that language. Therefore, we are not persuaded that the specification warrants importing into the claims a context for “automated manufacturing environment” given that: (a) an automated MES was already known to be part of an automated manufacturing environment, and (b) to avoid the inefficiencies of scheduling by WFTs, the solution was to provide a “software agent” that would reactively schedule events, which does not need additional context by referring to the automated manufacturing environment.

Accordingly, we are not persuaded that the preamble of the independent claims is limiting as Patent Owner argues.

Nevertheless, we address whether Patent Owner’s proposed construction of the preamble would have been appropriate under claim construction principles.

B. “automated manufacturing environment”

Patent Owner asserts that an “automated manufacturing environment is one in which multiple machines or resource operations are scheduled simultaneously.” 1342 Sur-reply 3; 1344 Sur-reply 3. Patent Owner relies on Mr. Humphrey’s deposition in which he testified that “factory automation in general is presumed to be fabwide automation.” Humphrey Depo., 106:1–20. Mr. Humphrey testifies that “all of these patents and exhibits deal with factory automation and scheduling kinds of issues,” and that “we’re not talking about an isolated [], a single tool kind of incident.” In sum, Mr. Humphrey testified that claims of the ’248 and the ’305 patents require scheduling multiple machines and/or resource operations simultaneously throughout a large semiconductor production facility. *Id.* at 108:7–109:17; *see also* 1342 Reply 3 (citing Humphrey Depo., 108:7–109:5 as the source for the contention that scheduling multiple machines or resource operations simultaneously throughout large semiconductor manufacturing comes from the preamble), 1344 Reply 3 n.2.

We are not persuaded by Patent Owner’s proposed construction of “automated manufacturing environment”—even if the preamble were limiting. Patent Owner’s arguments are an attempt to distinguish the claims from the prior art because, according to its argument, the claims would require “fabwide automation” versus a single tool automation. 1342 Sur-reply 3; 1344 Sur-reply 3. But the specification does not define “automated manufacturing environment” in any way, and any discussion of the “environment” is limited to discussing: (a) the field of the invention

(Ex. 1001, 1:19–21); (b) the use of prior art “automated MES” to view and manipulate machines or tools in the environment (*id.* at 2:27–31); and (c) the summary of the invention, which parrots the claim language without explanation (*id.* at 3:64–4:14). What we glean from the discussion of the term in the specification is that the “automated manufacturing environment” could include an “automated MES” and machines or tools. *Id.* at 2:27–31.

Furthermore, to the extent Patent Owner’s explanation of this term comes from the discussion of a “complex environment” of a fab, in the discussion of the background of the invention, the specification still does not support the meaning that Patent Owner urges us to adopt. The ’248 patent specification states that it is a challenge to manufacture 40,000 wafers, simultaneously, with the assistance of a computerized factory control system. *Id.* at 1:65–2:11. This passage describes the prior art environment without detail. For instance, there is no detail with which to assess the level of automation or the breadth of that automation (such as “fabwide”) that would provide for overcoming problems in the prior art by this term alone. Indeed, the improvements to the manufacturing facility of the prior art are brought forth by the claimed limitations themselves, not the preamble recitation of the environment in which they would be implemented. It is not clear from Patent Owner’s arguments, or the conclusory testimony of its expert, why the claims would be applicable only to “fabwide automation” or to simultaneous manufacturing when the claim elements are not constrained thusly. It seems that whether the manufacturing process involves one tool or a factory’s worth, the benefits of the invention would be realized regardless of the number of events occurring “simultaneously” or whether there is full

automation or some automation in the “automated manufacturing environment.”

Consequently, we are not persuaded that Patent Owner’s proposed construction of the term is supported by the full record before us. For this reason, and for the reasons discussed *supra* § IV.B, we are not persuaded that the preamble, including the term “automated manufacturing environment” is limiting, but if it were, its scope would be in accordance with its plain and ordinary meaning.

C. “integrated, automated process flow”

Claims 1 and 14 of the ’248 patent recite “automatically detecting an occurrence of a predetermined event in an integrated, automated process flow.” Ex. 1001, 30:42–43, 32:5. Claims 1, 12, 19, and 33 of the ’305 patent recite only the “process flow,” without the added “integrated” or “automated” qualifiers. Ex. 1002, 39, 54–55, 41:1–2, 41:61–62, 43:54. Neither party has proposed an express construction of the term. However, Patent Owner presents arguments regarding the words “integrated” and “automated” with regard to the process flow that indicate an implied construction. For instance, Patent Owner argues that neither Schulze nor Gupta teaches an “integrated, automated process flow” noting that the patent specification refers to software agents that are integrated with other existing factory control system, and software agents that also interface with software components of the MES and AMHS. *See* 1342 PO Resp. 24–25 (citing Ex. 1001, 6:47–54; Humphrey Decl. ¶ 70); *see also* 1344 PO Resp. 24–25, 8 (arguing that the “process flow” is an “automated” process flow, despite the claim language omitting that requirement), 9 (arguing that the Schulze does not disclose an “integrated or automated process flow”). Then, Patent

Owner argues that Figure 1 of the challenged patents depicts the process flow as including portions of the MES and an AMHS, and other integrated factory controls. 1342 PO Resp. 25 (citing Ex. 1001, 5:26–29); 1344 PO Resp. 25. According to Patent Owner, neither Schulze nor Gupta discloses “an integrated process flow, much less the specific integration of an automated material handling system (AMHS).” 1342 PO Resp. 25 (citing Humphrey Decl. ¶ 72); 1344 PO Resp. 25.

Petitioner responds that nothing in the specification of the challenged patents suggests limiting the “integrated process flow” to the process flow 100 shown in Figure 1, which includes an AMHS. 1342 Reply 7; 1344 Reply 7 (making identical argument regarding the ’305 patent, even though those claims recite the “process flow” without further qualifiers). Indeed, Petitioner points out that the specification refers to the process flow of Figure 1 broadly, to be applied to other types of manufacturing processes. 1342 Reply 7 (citing Ex. 1001, 5:5–8; Humphrey Depo. (Ex. 1046) at 93:8–19; 95:20–96:18); 1344 Reply 7–8 (citing Ex. 1001, 5:3–6). Further, according to Petitioner, Patent Owner’s argument is an improper attempt to import a preferred embodiment into the understanding of the claim terms. 1342 Reply 7–8 (citing *Cisco Sys., Inc. v. TQ Delta, LLC*, 928 F.3d 1359, 1364 (Fed. Cir. 2019) (“[I]t is improper to read limitation from a preferred embodiment described in the specification – even if it is the only embodiment – into the claims absent a clear indication in the intrinsic record that patentee intended the claims to be so limited.”)); 1344 Reply 8.

We agree with Petitioner that claim term “integrated, automated process flow” does not require the inclusion of an AMHS. The specification of the challenged patents describes broadly the process flow as one that

“fabricates semiconductor devices.” 1001, 5:5–8. However, the invention may be applied to other types of manufacturing processes. *Id.* Indeed, the specification makes clear that, although the description of the process flow uses semiconductor fabrication terminology, the wafer lots instead will be referred to generically as “work pieces.” *Id.* at 5:8–16. Thus, the invention is described without pinning it to the fabrication of wafers or processing of wafer lots. And the AMHS is, admittedly, for handling the wafer lots and facilitating their transport from one station to another, as well as other locations in the process flow. *Id.* at 5:29–32. Therefore, given that the specification broadly describes the invention as a process flow that is generic, and not specific to those handling wafer lots, we decline to import into the claim term “integrated, automated process flow” the requirement of including an AMHS or any other equipment that is specific to wafer manufacturing.

During oral argument, Patent Owner presented argument that,

Integrated is different than automated. Integrated is referring to the fact that you have a software scheduling agent that’s actually integrated with a number of processes in this automated process flow. It’s not limited to a single machine. It’s a system that is integrated and is designed to take the human inefficiencies out, and to automate the process so that the materials flowing through this automated process flow do so efficiently.

Tr. 14:17–23. And Patent Owner agreed that the claimed process flow “is not specific to any particular type of manufacturing.” *Id.* at 14:24–25.¹¹

¹¹ *But see* 1342 PO Sur-reply 5–6 (arguing that claimed “process flow” and the depicted process flow 100 of Figure 1 of the ’248 patent are indistinguishable and that an AMHS is required); 1344 PO Sur-reply 6 (same argument for the ’305 patent).

However, in describing the role of the AMHS in the integrated, automated process flow, Patent Owner posits that the AMHS “is perhaps not required in every situation of an automated process flow, but it likely is because, again, you’re trying to take the human element out, and therefore the automated material handling system would likely be part of any [integrated,] automated system.” *Id.* at 16:16–21.

We agree with Patent Owner that “integrated” is different than “automated,” but the issue here appears centered on whether the claim would require an AMHS because of the alleged objective of removing “human inefficiencies” from the prior art process flow. We are not persuaded that the word “integrated” has such an import. As admitted by Patent Owner, the word “integrated” merely denotes the interface of the scheduling agents with other processes. Tr. 14:17–23; 1342 PO Resp. 24–25 (stating that the specification describes the “integrated” aspect of the invention as software agents interfacing with other software components and also being “integrated” with other factory control systems);¹² *see also* Tr. 17:16–25 (describing “integrated” with respect to how etching, deposition, measuring tools are “integrated” together and the software service agent can consider the information and make a decision). Thus, the “integrated” qualifier of the process flow does not support Patent Owner’s argument.

Nor does the word “automated,” although it may be interpreted to imply efficiency in manufacturing, necessitate the inclusion of the AMHS as a matter of claim construction. As discussed above with regard to the preamble, the claim does not specify the level of “automation” needed in the claimed process flow. Patent Owner concedes that whatever the “process

¹² Patent Owner repeats the same argument in 1344 IPR pages 24–25.

flow is . . . you’re trying to take the human element out of it and you’re trying to put [in] a software scheduling agent or agents.” Tr. 15:5–7. As stated above, the prior art already encompassed some automation by using an automated MES. Ex. 1001, 2:27–31. But the problems concerning the inefficiencies carried on by a WFT, even when using an automated MES, were solved with the scheduling decisions made with the software scheduling agents, which is a separate and distinct claim limitation. *Id.* at 2:45–3:22. Finally, Patent Owner does not point to anything in the specification or the claim language that attributes to the claimed “process flow” any particular level of automation of wafer lot handling and transporting performed by an AMHS.

Consequently, we conclude that the term “integrated, automated process flow” does not require the inclusion of an AMHS.

D. “software scheduling agent”

All challenged independent claims recite a “software scheduling agent.” Neither party expressly proposed a construction for this term. However, Patent Owner has raised arguments bearing on the scope of the term by arguing that the claims require “fab-wide” resource scheduling (1342 PO Resp. 18–22) and a “dynamic globally-reactive scheduling system” (*id.* at 23).¹³ We discuss each of these arguments in turn.

1. Resource Scheduling Agent

According to Patent Owner, “resource scheduling is a fundamental aspect of the invention of the ’248 patent.” 1342 PO Resp. 18 (citing

¹³ Patent Owner presents identical arguments for the ’305 patent in the 1344 IPR. 1344 PO Resp. 18–22. Parallel citations to the 1344 IPR are therefore omitted.

Ex. 1001, 7:20–30; 1342 Humphrey Decl. ¶ 55). The ’248 patent states that the principal types of scheduling agents in the illustrated embodiment of Figure 3 include a lot scheduling agent, a machine scheduling agent (MSA), a PM scheduling agent, and a resource scheduling agent. Ex. 1001, 7:20–30. And as Petitioner points out, the specification also states that there may be many different types of scheduling agents depending on the implementation. 1342 Reply 9–10.¹⁴ Indeed, the specification describes that each software agent represents some manufacturing domain entity, which may include one of a series of disclosed entities: a lot, a process tool, a resource, a PM, or a Qual. Ex. 1001, 6:40–43. Each software agent reactively schedules, initiates, and executes activities on behalf of its respective manufacturing domain entity. *Id.* at 6:63–66. None of the citations in the challenged patents provided by Patent Owner support the notion that the scheduling agent should be construed to include any or all of the specific types of scheduling agents described in the specification. The description of the resource scheduling agent is not described as fundamental, as Patent Owner asserts, and there is no definition of the term “software scheduling agent” that would require the inclusion of the resource scheduling agent as a type of software scheduling agent.

The claim language likewise does not warrant importing into the term such a limitation. Claim 1 of the ’248 and ’305 patents (as well as claims 12 and 19 of the ’305 patent) require notifying a software scheduling agent of the occurrence of an event and then reactively scheduling an action from the software scheduling agent responsive to the detection. Ex. 1001, 20:44–48;

¹⁴ Petitioner’s reply arguments on this issue are substantively identical for the ’305 patent. Accordingly, parallel citations to the 1344 IPR are omitted.

Ex. 1002, 39:56–60, 41:3–7, 41:63–67. This claim language ascribes to the software scheduling agent an action that is agnostic as to which “manufacturing entity domain” is involved. In other words, regardless of which type of domain is involved—resource, a lot, or machine—the claimed software scheduling agent is required to reactively schedule an action for the entity for which the scheduling agent is responsible, in response to the detected event.

Claim 14 of the '248 patent and claim 33 of the '305 patent also recite the “software scheduling agent” broadly as being “capable of reactively scheduling appointments for activities in the process flow responsive to an automatic detection and notification of a plurality of predetermined events.” Ex. 1001, 32:7–11; Ex. 1001, 43:48–50, 44:54–58 (claim 44 of the '305 patent recites similar language except it requires scheduling appointments for processing the work pieces through the process stations, instead of for activities in the process flow). Again, this language is agnostic as to which manufacturing domain entity the software scheduling agent is monitoring and scheduling for. For instance, an MSA receives any changes that occur to a particular machine. Ex. 1001, 7:61–62. If the availability of the machine changes, the MSA subscribed to monitor for notifications from that specific machine receives an alert and reacts appropriately. *Id.* at 7:62–67. Likewise, the change of an appointment for processing a lot causes a notification for the corresponding lot scheduling agent, which will then change its calendar accordingly. *Id.* at 9:51–59. Regardless of whether it is a machine or a lot, the claimed software scheduling agent is notified of an event, and then reactively schedules an appointment for a corresponding manufacturing entity domain in response to the event. It is therefore

unreasonable to read the claim as requiring one or more of a specific type of the disclosed scheduling agents, especially because, as discussed above with respect to the process flow, the specification states that the manufacturing process may not be limited to semiconductor device manufacturing.

Ex. 1001, 5:10–13. It stands to reason then that it would not be proper to import into the claimed “software scheduling agent” the limitation that Patent Owner seeks: the inclusion of a resource scheduling agent. *Trebro Mfg., Inc. v. Firefly Equip., LLC*, 748 F.3d 1159, 1166 (Fed. Cir. 2014) (a proposed construction is incorrect if it “improperly imports a limitation into the claim from a preferred embodiment.”).

2. *Dynamic Globally Reactive Scheduling*

Patent Owner argues that the challenged patents teach and *claim* a globally-reactive scheduling system. 1342 PO Resp. 23; *see also* 1342 Sur-reply 9 (stating that claims 1 and 14 of the ’248 patent recite fab-wide, globally reactive scheduling).¹⁵ Specifically, Patent Owner argues that the specification describes an embodiment in which software scheduling agents perform scheduling changes throughout the scheduling system. *Id.* (citing Ex. 1001, 29:26–35). That portion of the specification states that “as booked appointments are shifted, canceled, shrunk, expanded, and rescheduled, the changes can ripple through the process flow and, in particular, the calendars.” Ex. 1001, 29:26–35. However, the passage also states that “[c]hanges are instituted by a single software agent, but a changed

¹⁵ Patent Owner presents identical arguments for the ’305 patent in the 1344 IPR. 1344 PO Resp. 23. Accordingly, parallel citations to the 1344 IPR hereinafter on this issue are omitted. Subsequent citations to the 1344 Sur-reply are likewise omitted. 1344 Sur-reply 13 (arguing that claims 1, 12, and 19 recite “fab-wide reactive scheduling”).

appointment may be booked on multiple calendars.” *Id.* Thus, software scheduling agents communicate with other software agents so they can update their calendars accordingly. *Id.*

As for the “dynamic” aspect of Patent Owner’s contention, Patent Owner notes that the above-cited passages of the specification describe “real-time communication.” 1342 PO Resp. 23. According to Patent Owner, this manner of communication in real-time is different from the prior art manner of real-time communication because the prior art relies on a “static set of global parameters,” while the software scheduling agents of the present invention do not. *Id.*; *see also id.* at 25 (arguing that the absence in the prior art of dynamic, as opposed to static, features is fatal to Petitioner’s argument).

Petitioner responds that the record does not support Patent Owner contentions. Specifically, according to Petitioner, Mr. Humphrey’s testimony confirms that claim 1 of the ’248 and ’305 patents do not require fab-wide scheduling and that performing scheduling for one tool in the fab would still be covered by the claim. 1342 Reply 12 (citing Humphrey Depo., 103:20–104:3, 110:8–14); 1344 Reply 12–13.¹⁶ Petitioner also asserts that the specification and prosecution history do not support Patent Owner’s position. Particularly, Petitioner points out portions of the specification that describe the “software scheduling agent” as being associated with a single manufacturing domain entity and that reference to the functionality of making changes throughout the process flow are cabined by the disclosure that each software scheduling agent updates its own

¹⁶ Petitioner’s presents the same arguments for the ’305 patent in the 1344 Reply, which will not be cited with particularity hereinafter. 1344 Reply 12–16.

calendar. 1342 Reply 12 (citing Ex. 1001, 6:40–43, 6:63–66, 7:17–19, 9:60–10:2, 11:36–39, 12:15–18, 29:26–35; 1342 Shanfield Decl. ¶ 65; 1342 Humphrey Decl. ¶ 42). Thus, the specification describes multiple scheduling agents, each associated with a specific domain entity—not a single scheduling agent that schedules for multiple machines or performs simultaneous resource operations throughout a large semiconductor facility. 1342 Reply 12–13.

We agree with Petitioner that the claim language and the specification do not support Patent Owner’s contention that the “software scheduling agent” is required to perform dynamic, globally-reactive scheduling. As noted above, claim 1 of the ’248 and ’305 patents (as well as claims 12 and 19 of the ’305 patent) require notifying a software scheduling agent of the occurrence of an event and then reactively scheduling an action from the software scheduling agent responsive to the detection. Ex. 1001, 20:44–48; Ex. 1002, 39:56–60, 41:3–7, 41:63–67. The claims focus on the occurrence of *at least one event*, of which the software scheduling agent is notified and reacting accordingly. There is no indication in the claim language that the software scheduling agent needs to perform any actions in either a “global” scale or for more than one manufacturing domain entity. Not surprisingly, Mr. Humphrey’s testimony confirms this understanding. Humphrey Depo., 103:20–104:3, 110:8–14.

Claim 14 of the ’248 patent and claim 33 of the ’305 patent also recite the “software scheduling agent” broadly as being “capable of reactively scheduling appointments for activities in the process flow responsive to an automatic detection and notification of a plurality of predetermined events.” Ex. 1001, 32:7–11, 43:48–50, 44:54–58 (claim 44 of the ’305 patent recites

similar language except it requires scheduling appointments for processing the work pieces through the process stations, instead of for activities in the process flow). These claims focus on the occurrence of more than one event, but do not convey that the appointments are scheduled for more than one manufacturing domain entity, much less in a “global” scale of a manufacturing facility.

With respect to the “dynamic” feature argued by Patent Owner, we are also unpersuaded that the claim requires it. First, it is unclear what actions of the “software scheduling agent” are required to be “dynamic” and in what sense. The claims do not require a “real-time” reactive action—only that the action be reactively scheduled in response to the detected event. There is no need to import to the claim a requirement of “dynamic” scheduling because the claim does not require it and the specification fails to describe as narrowly as Patent Owner argues. To the extent the argument is that “globally-reactive” alludes to the functionality of responding to events that are occurring in the process flow, that functionality is captured by the claim language itself without any specific timing (i.e., real-time or dynamic): reactively scheduling responsive to the (automatic) detection (and notification) of the predetermined event(s). And the specification confirms this understanding, stating that “[s]ome of these activities are scheduled reactively, i.e., in response to events occurring in e.g., the process flow 100, in accordance with the present invention.” Ex. 1001, 7:36–39.

In sum, we are not persuaded by Patent Owner’s arguments that the claims of the ’248 and ’305 patents require that the software scheduling agent perform “dynamic, globally-reactive scheduling” as the arguments are not supported by the claim language, the specification, and the testimony of record.

3. *District Court Claim Construction*

Finally, we discuss whether we should adopt the district court's construction for "software scheduling agent" that Petitioner introduced in the record as rebuttal to Patent Owner's arguments on this issue. Patent Owner faults Petitioner for raising the district court order on claim construction in its Reply because it was submitted late in the proceeding. 1342 Sur-reply 9. We are not persuaded by this argument. Our rules explicitly provide for our evaluation of district court claim construction orders. 37 C.F.R.

§§ 42.100(b). Under this provision, the Board will consider any prior claim construction determination in a civil action if that court has previously construed a term in the involved claim using the same standard and the claim construction determination has been made timely of record in the IPR proceeding. *Id.* And we give such other claim construction determinations appropriate weight. *See Patent Trial and Appeal Board Consolidated Trial Practice Guide November 2019*, 46–47 ("CTPG").¹⁷ Indeed, the CTPG states that submitting the prior claim construction is mandatory if it is relevant information that is inconsistent with a position advanced by the party during the proceeding. *Id.* at 47. The claim construction orders in district court, filed by Petitioner as Exhibits 1048 and 1049, were issued after the filing of the Petition but before Patent Owner filed its Response. *See* 1342 Reply 1 n.1; 1344 Reply 1 n.1. Patent Owner did not submit these orders despite taking positions that appear to be inconsistent with its arguments regarding the scope of the claims. For instance, Patent Owner presented to the district court the argument that the software scheduling agent would be limited to representing a single manufacturing domain at any

¹⁷ Available at <https://www.uspto.gov/TrialPracticeGuideConsolidated>.

given time. Ex. 1048, 29–30. It appears that in this proceeding, Patent Owner is deviating from that argument and urging a meaning for the software scheduling agent that goes beyond a single domain entity and instead monitors fab-wide events. Thus, regardless of when the district court claim construction was submitted, or by which party, it is appropriate for us to consider the district court claim construction order.

There are two district court orders concerning claim construction that are relevant to this proceeding. Exhibit 1048 is the Claim Construction Memorandum and Order issued by the Eastern District of Texas (Sherman Division), in which the court analyzed and construed the term “software scheduling agent” for the ’248 and ’305 patents. Ex. 1048, 27–31. Exhibit 1049 is the Claim Construction Order issued by the Western District of Texas (Waco Division), in which the court entered the construction for claim terms argued in a Markman hearing. Ex. 1049, 3. In both of these orders, the court construed the term as “a software agent that at least schedules activities on behalf of a single manufacturing domain entity at any given time.” *Id.*; Ex. 1048, 31 (noting that although Patent Owner sought no construction for the term, the record before the USPTO revealed an intent to define the term because of arguments made to overcome the Examiner’s rejection). We have reviewed the analysis provided by Judge Amos Mazzant of the Eastern District (Sherman Division) and find that the analysis soundly evaluates the statements made during prosecution by patentee seeking to clarify that “any software entity that schedules” cannot be a “software scheduling agent.” Ex. 1048, 30 (finding that patentee distinguished “software scheduling agent” from “any software entity that schedules”). We also agree with the district court analysis that the specification consistently and repeatedly describes software agents as

associated with a single manufacturing entity. *Id.* at 30–31 (citing Ex. 1002, 6:61–64, 7:15–17, 10:62–11:3, 12:36–39, 13:16–19; Ex. 1001, 6:63–67, 7:17–19, 10:64–11:5, 12:38–41, 13:18–21; *SciMed Life Sys., Inc. v. Advanced Cardiovascular Sys., Inc.*, 242 F.3d 1337, 1341 (Fed. Cir. 2001) (citing *Watts v. XL Sys., Inc.*, 232 F.3d 877, 882 (Fed. Cir. 2000))).

Patent Owner contends that the scope of “software scheduling agent” should not be limited to a “single” manufacturing domain entity because such a construction is contrary to the record and narrower than the district court’s construction. 1342 Sur-reply 9–10. We do not agree. The district court’s construction is “a software agent that at least schedules activities on behalf of *a single manufacturing domain entity* at any given time.” Patent Owner urges us to focus on the word “at least” contending that it could mean that the “software scheduling agent” is not limited to a single manufacturing domain entity—but that is not correct. The “at least” in the district court’s construction modifies the term “schedules activities.” This interpretation is consistent with the record, which indicates that the scheduling agent may perform other actions in addition to scheduling. *See* Ex. 1002, 6:61–64; Ex. 1048, 28 (analyzing and rejecting defendant’s contention that the scheduling agents would be required to perform the functions of schedule, initiate, and execute activities).

Patent Owner also urges us to focus on the words “at any given time” in the district court’s claim construction, as if those words mean a broadening of the software agent to perform reactive scheduling for a “global” or fab-wide operation. 1342 Sur-reply 9–10. That too is wrong. The phrase “at any given time” was used by patentee during prosecution to argue against the Examiner’s rejection. Ex. 1006, 204–205 (“For instant,

IPR2021-01342 (Patent 6,968,248 B1)

IPR2021-01344 (Patent 6,907,305 B2)

there is no support in Applicant[']s specification for the proposition that a scheduling agent represents more than one manufacturing domain entity at any given time or that a scheduling agent be implemented in anything other than software.”), 213–215. During the prosecution, the patentee unmistakably argued that the software scheduling agent “represent[s] some respective manufacturing domain entity” and would not “operate across the whole fab.” *Id.* at 166–67. Thus, Patent Owner’s argument that the term “software scheduling agent” cannot be limited to a single manufacturing domain is contrary to the statements made by Applicant in prosecution and cut against the findings made by the district court regarding prosecution estoppel, findings which we adopt here.

Consequently, we adopt the district court’s claim construction of “software scheduling agents” as meaning “a software agent that at least schedules activities on behalf of a single manufacturing domain entity at any given time.”

V. ANALYSIS OF OBVIOUSNESS OVER SCHULZE AND GUPTA

In the 1342 IPR, Petitioner challenged claims 1–22 of the ’248 patent as obvious over the combined teachings of Schulze and Gupta.

1342 Pet. 33–67. In the 1344 IPR, Petitioner challenged claims 1–25 and 33–53 of the ’305 patent as obvious over the combined teachings of Schulze and Gupta. 1344 Pet. 31–67. As stated previously, the independent claims of both patents recite substantially similar subject matter as noted above in Section III.C. And the majority of the arguments presented involve subject matter claimed in the independent claims. Therefore, for expediency, we address the parties’ arguments and evidence first with respect to the ’248 patent in the 1342 IPR and refer to similar arguments and analysis by

reference when discussing the claims of the '305 patent challenged in the 1344 IPR.

Before addressing the merits of Petitioner's contentions in light of Patent Owner's arguments, we summarize the asserted references.

A. Overview of Schulze (Ex. 1007)

Schulze is related to "systems and methods for monitoring and assessing the performance and operation of . . . semiconductor fabrication facilities." Ex. 1007 ¶ 3.¹⁸ Schulze describes a need to identify which fabrication tools of large semiconductor fabrication facilities are idle in order to reduce the idle time of the fabrication tools and maximize production time, yield and profitability. *Id.* ¶¶ 6, 7.

Figure 1 illustrates a semiconductor fabrication system incorporating an automated monitoring and assessment system and is reproduced below.

¹⁸ We note here that Schulze claims priority to U.S. Provisional Application No. 60/241,343, filed October 17, 2000 and qualifies as prior art under 35 U.S.C. § 102(e), a fact that is not disputed. *See* 1342 Pet. 23–24; 1342 Shanfield Decl. ¶¶ 84–86 (outlining support for the claim in Shulze in the provisional); *see generally* 1342 PO Resp., 1344 PO Resp.

FIG. 1

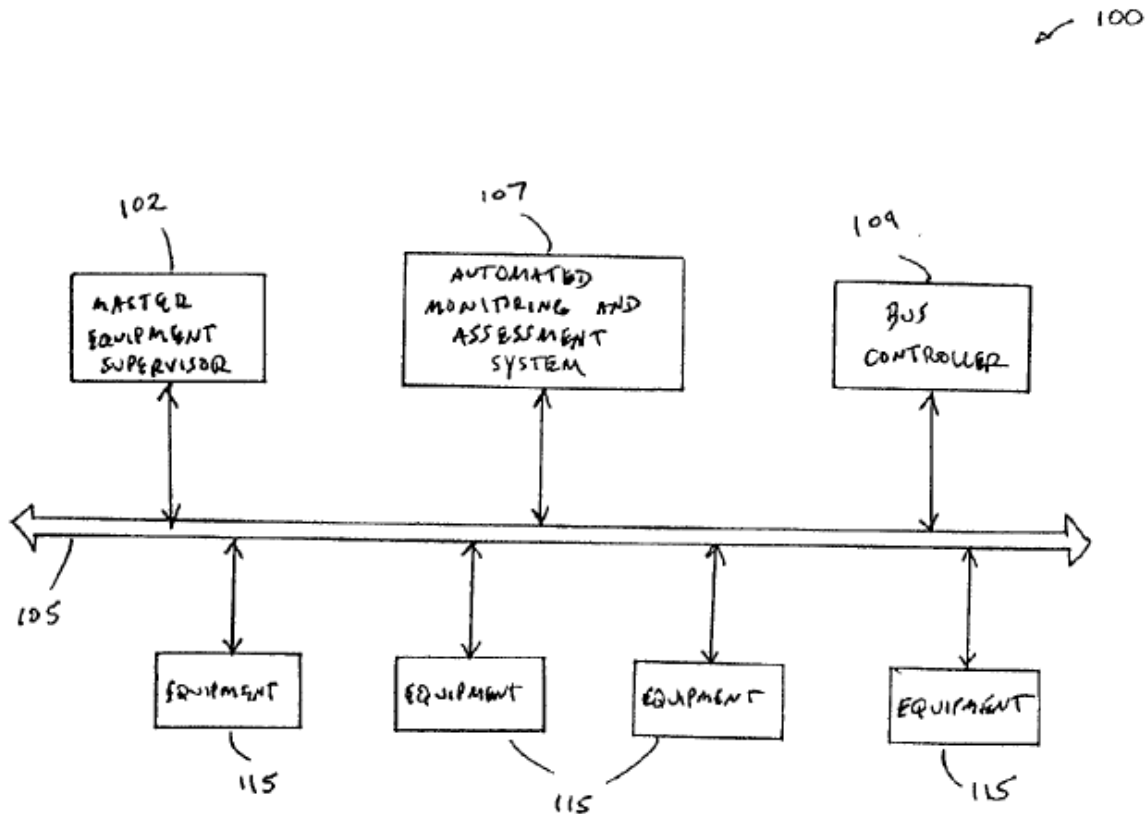


Figure 1 is a top-level diagram illustrating semiconductor fabrication system 100 incorporating an automated monitoring and assessment system. *Id.* ¶ 40. As illustrated in Figure 1, manufacturing execution system 102 is connected to system bus 105, along with a plurality of semiconductor fabrication tools 115. *Id.* Also connected to system bus 105 is automated monitoring and assessment system 107 and bus controller 109. *Id.* Bus controller 109 controls the routing of information over system bus 106, and automated monitoring and assessment system 107 subscribes to the information needed for performing the monitoring and assessment functions. *Id.* ¶ 41. Semiconductor fabrication tools 115 transmit or publish messages over system bus 105 to manufacturing execution system 102. *Id.* ¶ 42.

Automated monitoring and assessment system 107 receives information from the transmitted or published messages, and uses that information to track the operation states of the semiconductor fabrication tools 115. *Id.*

B. Overview of Gupta (Ex. 1008)

Gupta “relates to automated scheduling and planning systems.”

Ex. 1008, 1:9–10. More specifically, Gupta describes a system for scheduling the operation of interrelated machines (such as in a manufacturing facility for integrated circuits), which perform a process flow. *Id.* at [57], 3:50–51. A global definition of the system is made once, and each machine has an individual profile describing its local interaction with the system. *Id.* at [57]. However, local scheduling decisions for each machine are made based on that machine’s individual profile and the state of the manufacturing facility at the time a decision is needed. *Id.*

Gupta states that the “real-time portion of the scheduling system depends on local optimization to function efficiently.” *Id.* at 13:43–44. Thus, Gupta explains, instead of recalculating the complete global state for the system, each time a decision must be made, only the relevant local state is recalculated. *Id.* at 13:44–48. Such a process reduces processor load. *Id.*

Each machine in the manufacturing facility has several data structures that determine the machine behavior. *Id.* at 13:49–52. “Decision-making is event driven, and a determination of what comes next for each machine is made whenever certain events take place.” *Id.* at 13:54–56. Gupta identifies events that drive the decision making process: machine loads and unloads, a machine going off-line and coming on-line. *Id.* at 13:56–58. According to Gupta, whenever one of these events occurs, “the scheduling system must calculate what that machine will do next.” *Id.* at 13:59–60. Those actions,

Gupta explain, may be to load a lot immediately and to take the lot from an input queue. *Id.* at 13:61–64. Other actions may involve requiring a machine to wait for a full load, or to proceed with a partial load. *Id.* at 13:64–66.

Gupta’s scheduler, therefore, makes decisions when machines are due to load, or when they unload. *Id.* at 14:19–21. “Since the schedule knows in advance when its computational resources will be in demand, it is in a position to look ahead and predict when its resources will be inadequate to fully compute each required decision.” *Id.* at 14:21–26. “If a heavy demand on computational resources will be required at some time in the future, the scheduling system will need to begin making decisions ahead of time.” *Id.* at 14:30–33.

C. *Independent Claim 1 of the ’248 Patent*

We have determined above, in Section IV.A, that the preamble of the claim—“A method for scheduling in an automated manufacturing environment”—is not limiting. Thus, Patent Owner’s arguments that the prior art does not teach or suggest an automated manufacturing environment is not persuasive. *See* 1342 PO Resp. 8. In any event, Petitioner argues that notwithstanding the preamble not being a limitation, Schulze teaches it. According to Petitioner, Schulze describes an automated manufacturing environment with a non-intrusive, reliable, and comprehensive system or method for monitoring, assessing, and reporting the operation and performance of a semiconductor manufacturing facility (or “fab”) by connecting an automated monitoring and assessment system to a manufacturing execution system (MES) and fabrication tools via a system

bus. 1342 Pet. 34 (citing Ex. 1007 ¶¶ 14, 40; 1342 Shanfield Decl. ¶ 111); 1342 Pet. 41 (citing Ex. 1007 ¶¶ 39–40; 1342 Shanfield Decl. ¶ 131).

We find that, notwithstanding that the preamble is not limiting, Schulze teaches an “automated manufacturing system.” As discussed above in Section IV.B., the term “automated manufacturing system” would have a plain and ordinary meaning and does not require the notion of fabwide automation. Thus, Patent Owner’s arguments that rely on an interpretation of the claim that would require fabwide automation are not persuasive. *See* 1342 Sur-reply 2–3.

The Petition points to Schulze’s disclosure of a semiconductor fabrication facility that utilizes an automated MES that controls the manufacture of semiconductor wafers and other products according to a programmed recipe, by sending commands to the various fabrication tools and monitoring their activity. 1342 Pet. 41; Ex. 1007 ¶¶ 39, 40. In the passages relied on by Petitioner, Schulze describes the automated monitoring and assessment system as a computer system that uses a system bus for communicating with the equipment, which can be processing tools and/or metrology tools. Ex. 1007 ¶ 40. The Petition further addresses the “scheduling” of the preamble by asserting a combination with Gupta’s teachings—of a method “for scheduling the operation of interrelated machines[,] which perform a process flow” in a “highly automated” “front-end manufacturing facility for integrated circuits.” 1342 Pet. 41–42; Ex. 1008, code (57), 3:49–51, 3:57–58. Thus, Petitioner sets forth persuasively that the “automated manufacturing system” of the preamble is met by a combination of Schulze’s system, comprising an automated MES, system bus, and processing tools, and the teachings of Gupta of scheduling

operations in a process flow and that Gupta specifically addresses scheduling in a “highly automated” semiconductor manufacturing facility. We agree.

In Reply, Petitioner attempts to characterize Mr. Humphrey’s testimony as acknowledging that Schulze’s MES was automated. 1342 Reply 3–4 (citing Ex. 1046, 47:6–13, 50:9–54:19, 23:17–22, 25:3–26:10, 28:19–21, 31:12–32:19, 36:15–37:22, 39:6–40:9). Patent Owner objects to the characterization of Mr. Humphrey’s testimony. We agree with Patent Owner that Mr. Humphrey’s testimony did not go as far as Petitioner alleges. Nevertheless, as summarized above, the discussion in Schulze of the automated MES monitoring and controlling processing and measuring tools in a semiconductor fabrication facility, together with Gupta’s disclosure of scheduling operations in a process flow of a highly automated semiconductor fabrication facility supports that the combination of Gupta and Schulze teaches an “automated manufacturing environment.”

Thus, we conclude that the preamble is not limiting, but Petitioner has nevertheless shown by a preponderance of the evidence that the combination of Schulze and Gupta teaches “automated manufacturing environment.”¹⁹

1. *“automatically detecting an occurrence of a predetermined event in an integrated, automated process flow”*
 (“process flow” limitation)

We have determined above, in Section IV.C., that the term “integrated, automated process flow” does not require the inclusion of an AMHS. Petitioner relies on Schulze as teaching the process flow limitation

¹⁹ We address below and separately the sufficiency of the evidence on reasons to combine given Patent Owner’s numerous arguments in opposition.

because it discloses that the automated MES is connected to the system bus, along with a plurality of semiconductor fabrication tools. 1342 Pet. 42; Ex. 1007 ¶ 40. Schulze also discloses that the MES monitors the connected fabrication tool's activity by detecting changes in the machine operation, such as unscheduled downtime, scheduled downtime, standby time, and productive time. 1342 Pet. 42; Ex. 1007 ¶¶ 40, 55, 214. Therefore, Petitioner contends that Schulze teaches the limitation of claim 1 that requires "automatically detecting an occurrence of a predetermined event in an integrated, automated process flow." Pet. 42 (citing 1342 Shanfield Decl. ¶¶ 132–33).

Patent Owner argues that Schulze does not teach or suggest the process flow limitation because Schulze is limited to monitoring and assessing tool states and reporting tool metrics to a conventional MES. 1342 PO Resp. 8–9. Patent Owner characterizes Schulze's MES as conventional in an attempt to distinguish Schulze as lacking other necessary components of the claimed "process flow." For instance, Patent Owner argues that the challenged patents require software agents and AMHS in the recited "process flow." *Id.* at 11 (contrasting Schulze with the '248 patent on the basis of "key elements" of software agents and AMHS), 9 (distinguishing Schulze on the basis that it does not schedule appointments for activities in a process flow). Patent Owner's arguments are not persuasive.

First, as already stated, we have determined that the term "integrated, automated process flow" does not require an AMHS. Second, the "process flow" limitation does not recite the "software scheduling agents." That limitation is separate and distinct from the "integrated, automated process flow." *See* Ex. 1001, 30:44–45 ("automatically notifying a software

scheduling agent of the occurrence”). In any event, Petitioner does not rely on Schulze alone as disclosing the “software scheduling agent”—Petitioner relies on Gupta for that limitation. 1342 Pet. 42–45. Thus, Patent Owner’s arguments are not commensurate with claim scope, which does not require the AMHS as part of the “integrated, automated process flow.” Nor are the arguments responsive to Petitioner’s challenge, which relies on Gupta’s scheduler as disclosing the “software scheduling agent,” even if that agent were part of the recited “process flow”—a position that has no support in the claim language, as already explained.

We are persuaded nevertheless that Schulze teaches the “process flow” limitation because it describes a MES interfacing and communicating with the processing and measuring tools of the semiconductor manufacturing process. Ex. 1007 ¶¶ 40, 55, 214. The MES is in communication with (i.e., integrated to) the various equipment of the fabrication facility. *Id.* This “equipment” is the fabrication tools to which the MES sends commands for controlling the manufacture of the semiconductor wafers according to a programmed recipe. *Id.* ¶ 40. For each tool, the MES tracks six top-level states, intermediate states, and sub-states beneath each intermediate state. *Id.* ¶ 55. The MES also includes system variable IDs that are mapped to certain triggers that are activated when a machine changes states. *Id.* ¶ 214.

Thus, based on the passages described above, we find that Schulze’s system is a process flow in which the occurrence of a predetermined event is automatically detected. More specifically, Schulze’s system monitors and controls the fabrication of wafers across various equipment in a semiconductor fabrication facility. Ex. 1007 ¶ 40. We also find that Schulze’s process flow is automated as it involves an MES that, like the one disclosed in the challenged patents, is an automated MES that, once

programmed, keeps track of states in the fabrication tools and controls the manufacture of the semiconductor wafers. *Id.* ¶¶ 40, 214; *see also* 1342 PO Resp. 10–11 (arguing that Schulze’s system is a portion of the patented system, including the MES, which the patent describes as an automated MES (Ex. 1001, 2:27–31), user interface, and computing device).²⁰ And finally, Schulze’s process flow is “integrated” because its MES interfaces and communicates with the equipment over a system bus and also communicates with other computers in the system, such as the automated monitoring and assessment system. Ex. 1007 ¶¶ 40, 41; *see* Tr. 14:17–23; 1342 PO Resp. 24–25 (stating that the specification describes the “integrated” aspect of the invention as software agents interfacing with other software components and also being “integrated” with other factory control systems); *see also* Tr. 17:16–25 (describing “integrated” with respect to how etching, deposition, measuring tools are “integrated” together and the software agent can consider the information and make a decision). Based on the information the MES gathers concerning the state of the equipment, Schulze generates a trigger when there is a change of one state to another

²⁰ Petitioner also relies on other teachings of Schulze that explain the communication standards used to assess equipment availability, reliability, and to process the information. 1342 Reply 8 (citing Ex. 1007 ¶¶ 5, 6, 8–10, 12, 55, 64). Patent Owner rejects these citations of Schulze as teaching mere standards that do not describe how to gather and process the necessary information. 1342 Sur-reply 6. Although we do not rely on these citations expressly, we find Patent Owner’s argument not persuasive. The citations provided by Petitioner show that Schulze contemplated using these standards to automate the gathering of the state information for each machine and to further implement its data collection techniques to build a trigger system with minimum modifications to the existing control systems, tools, or equipment. Ex. 1007 ¶¶ 5, 6, 8–10, 12, 14, 55, 64, 214.

according to the preprogrammed mappings. Thus, a change of state in the process flow is a predetermined event that occurs and is automatically detected using Schulze's triggers.

Petitioner also, in its Reply, argues that Gupta teaches a process flow. 1342 Reply 8 (citing Ex. 1008, code (57), 3:49–59). Patent Owner argues that reliance on Gupta at the Reply stage comes too late because the Petition relies only on Schulze for the limitation. 1342 Sur-reply 4 (citing Shanfield Depo., 75:22–76:7). We agree that, to the extent the recited “process flow” is separate and distinct from the recited “software scheduling agent,” the Petition asserts that Schulze alone teaches the limitation. However, we note here that although not expressly stated as such, Patent Owner's argument implies that the “process flow” must also include the “software scheduling agent.” 1342 PO Resp. 12–15. As stated above, we do not agree with that interpretation because these limitations are recited distinctly and separate from each other, without the claim requiring the software agent to be subsumed by the process flow. Indeed, claim 14 of the '248 patent recites the integrated process flow as one limitation distinct from the computing system that includes a plurality of software scheduling agents. Ex. 1001, 32:5–8. Nor is there any indication in this claim language that the invention requires the process flow to incorporate the agent.

However, for completeness, if the claim required the recited “process flow” to include the “software scheduling agent,” Petitioner position is very clear that Gupta is relied for its teaching of the “scheduler,” and it is the combination of Schulze and Gupta that teaches the “software scheduling agent” as discussed in more detail below. Accordingly, the argument that

Schulze does not teach a “software scheduling agent” or an AMHS as part of its process flow is unavailing.

Consequently, we determine that Petitioner has shown by a preponderance of the evidence that Schulze teaches the “process flow” limitation.

2. *“automatically notifying a software scheduling agent of the occurrence” (“automatically notifying” limitation)*

Petitioner argues that Gupta discloses a scheduler implemented in software that constitutes the claimed “software scheduling agent.” 1342 Pet. 42–43 (citing Ex. 1008, 30:3–16; 1342 Shanfield Decl. ¶¶ 65, 72–81, 134). According to Petitioner, Gupta’s scheduler makes decisions for a given machine in the process flow by applying the “local prediction” concept. *Id.* at 43 (citing Ex. 1008, 1:34–48, 3:57–66, 14:8–26, 16:8–17, 17:7–13, 20:5–8, 20:5–14, 25:22–41, 25:52–55; 1342 Shanfield Decl. ¶ 134). Therefore, Petitioner argues, Gupta’s decision-making is on a real-time basis, requiring the scheduler to be automatically notified of the event detected at the fabrication facility. *Id.* (citing Ex. 1008, 2:51–52; Shanfield Decl. ¶ 135).

Patent Owner’s arguments challenging Petitioner’s assertions focus on “software scheduling agent” as requiring a resource scheduler and dynamic, globally reactive scheduling. *See* 1342 PO Resp. 16–22. We discuss these arguments in detail with respect to the next limitation of the claim that recites “reactively scheduling an action from the software scheduling agent.” As for the “automatically notifying” limitation, Patent Owner’s arguments do not address whether the combination of teachings of Schulze and Gupta would meet the automatic notification of the occurrence detected in the

previous limitation. Instead, Patent Owner challenges Petitioner's reasons to combine the teachings of Schulze and Gupta.

First Patent Owner focuses on Schulze's shortcomings. For instance, Patent Owner argues that Schulze is not analogous art because it is not in the same field of endeavor of the challenged patents. 1342 PO Resp. 15. Patent Owner also argues that the *challenged patents* teach away from the combination. 1342 PO Resp. 13–14 (stating that the challenged patents mention tools briefly in the background and that they teach away from Schulze's simple MES system, which is only one component of the comprehensive scheduling system disclosed in the patents). Further, according to Patent Owner, Schulze's mention of "scheduling" is limited to tools and states—a far cry from the scheduling disclosed in the challenged patents. *Id.* at 12–13. Thus, according to Patent Owner, Schulze is not relevant to the claims because it is missing scheduling, use of software agents, and reactively scheduling appointments for activity in the process flow. *Id.* at 14–15.

Second, Patent Owner argues that Gupta's local optimization would not have led a person of ordinary skill in the art to a combination with Schulze because the "local approach" of Gupta would not be implemented in a fab-wide integrated, reactive scheduling approach. 1342 PO Resp. 26–27 (relying on 1342 Humphrey Decl. ¶ 79).

As for additional arguments challenging the motivation to combine, Patent Owner contends that Gupta's scheduler has a limitation of six-minute steps that are incompatible with the "integrated fab-wide system for reactive scheduling of the type disclosed" in the challenged patents. *Id.* at 28 (citing 1342 Humphrey ¶ 82). In sum, Gupta's scheduler, Patent Owner states,

could not be adapted to schedule multiple machines or resource operations simultaneously throughout a large semiconductor production facility without building inherent and unavoidable inefficiencies and increased risk for misprocessing. *Id.* at 28 (citing 1342 Humphrey Decl. ¶ 82). We address each argument in turn (except that we address the six-minute time steps relating to Gupta when discussing the “reactively scheduling” limitation below as the discussion is more relevant to that limitation).

a) Schulze—Analogous Art

We first address Patent Owner’s contention that Schulze is not analogous art. “To be considered within the prior art for purposes of the obviousness analysis, a reference must be analogous.” *Circuit Check Inc. v. QXQ Inc.*, 795 F.3d 1331, 1335 (Fed. Cir. 2015). Criteria for determining whether prior art is analogous may be summarized as “(1) whether the art is from the same field of endeavor, regardless of the problem addressed, and (2) if the reference is not within the field of the inventor’s endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved.” *In re Clay*, 966 F.2d 656, 658–59 (Fed. Cir. 1992). Patent Owner cites *Wyers v. Master Lock Co.*, 616 F.3d 1231 (Fed. Cir. 2010) to argue that at the time of the invention a person of ordinary skill in the art would neither consider Schulze as belonging to the same field of endeavor nor consider it reasonably pertinent to the problem the invention is intended to resolve. 1342 PO Resp. 15. We are not persuaded by Patent Owner’s arguments.

Schulze is in the same field of endeavor as the challenged patents. *See* Ex. 1007 ¶¶ 3, 5. Schulze describes semiconductor fabrication in the same vein as the challenged patents: complex and involved, having hundreds of tools, each performing a process dictated by a given recipe,

where some machines are idle waiting for the output of an upstream tool, and it is a challenge to reduce the idle time to the maximum extent possible to maximize production time, yield, and profitability. *Id.* ¶¶ 5–6; Ex. 1001, 2:12–14 (describing the monitoring needed for efficient management), 2:15–26 (describing the challenge of performing downtime functions for a machine without impeding the manufacturing process itself). The field of endeavor is the same—monitoring the semiconductor fabrication machines to increase their efficiency by reducing idle time or time spent in non-production. Therefore, we are not persuaded by Patent Owner’s arguments that Schulze is not analogous prior art.

Further, as Petitioner points out, and we agree, the challenged patents address the problem of efficient management of a facility that requires monitoring the manufacturing process by WFTs and finding ways to improve the efficiency of the fab. 1342 Reply 18–19 (citing Ex. 1001, 2:12–14, 3:8–13; 1342 Shanfield Decl. ¶ 64). The challenged patents, Petitioner argues and we agree, also recognized the complex nature of tracking lots through the fab. *Id.* at 19. Schulze is concerned with the same problem of monitoring and assessing the performance and operation of equipment in semiconductor fabrication facilities. *See* Ex. 1007 ¶¶ 3, 8 (acknowledging the need of assessment of semiconductor manufacturing efficiency through tracking of equipment states), 10 (discussing the problem of interconnecting machines and tools from different manufacturers to assess the machine’s availability, reliability, and maintainability), 55 (defining states for each semiconductor tool connected to the system using the standards); Ex. 1003 ¶ 94. Just as the challenged patents describe, Schulze attests to the importance of a comprehensive system for monitoring,

assessing, and reporting the operation and performance of semiconductor facilities. Ex. 1007 ¶ 14. This is the basic system to which a further modification of Schulze is suggested by the teachings of Gupta—the integration of a scheduler that reacts to the triggers that Schulze has put in place to monitor and assess the tools’ states. It is not relevant that Schulze itself does not disclose a scheduler, or reactive scheduling because the obviousness theory presented by Petitioner relies on Gupta’s teachings for the scheduling. And Gupta is also prior art that addresses efficiency of manufacturing facilities and recognizes that scheduling the flow of goods (raw and partially finished) through a large manufacturing facility is a significant problem. Ex. 1008, 1:11–17.

Accordingly, we are not persuaded by Patent Owner’s arguments that Schulze, because it does not disclose scheduling in the same vein as the required “reactive scheduling,” is outside our consideration for obviousness under a non-analogous art theory.

b) Teaching Away Argument

Patent Owner argues that the challenged patents teach away from considering Schulze because they involve a “conventional MES” and tool monitoring with an MES is not relevant to the challenged patents. 1342 PO Resp. 13–14. According to Patent Owner, the challenged patents describe deficiencies in the MES because although sufficient for tracking lots and machines, they are passive in nature, lack advanced scheduling, and are unable to support highly automated factory operations. *Id.* at 14 (citing 1342 Humphrey Decl. ¶ 45). Specifically, Patent Owner asserts that despite describing that “an automated MES, such as WORKSTREAM” is a feature of its scheduling system and method, the specification identifies the drawbacks of an MES, including the limited extent of manipulating the

status of machines and tools. 1342 Sur-reply 14–15 (*comparing* Ex. 1001, 6:35–36, Fig. 1, *with id.* at 2:29–30; 2:47–49). Therefore, Patent Owner concludes, a person of ordinary skill in the art would not turn to Schulze to consider a different use of an MES or consider Schulze as pointing the way to automated fab-wide scheduling. *Id.* at 15.

We are not persuaded by Patent Owner’s argument. First, the argument that the specification of the challenged patents teaches away from considering Schulze as prior art is legally flawed. The application of this doctrine focuses on whether the *prior art teachings* would have discouraged the person of ordinary skill in the art from pursuing the path taken by the patentee. *See Allied Erecting v. Genesis Attachments*, 825 F.3d 1373, 1381 (Fed. Cir. 2016) (citing *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994) (analyzing whether the disadvantage in the prior art reference militates against finding the combination proper)). Thus, the fact that the specification describes that the conventional automated MES was not the solution to the problem addressed in the challenged patents does not warrant discarding Schulze as prior art merely because Schulze relies on the same type of MES.

Second, Patent Owner’s argument that the specification somehow would discourage a person of ordinary skill in the art from considering Schulze is not supported in either law or fact. The challenged patents do not discredit the use of a conventional MES. Rather, as Patent Owner recognizes, the challenged patents describe how the automated MES would be part of the resulting system. 1342 Sur-reply 14 (citing Ex. 1001, Fig. 1, item 270 (MES)); *see also* 1342 Reply 16–17 (arguing that the evidence of record shows Schulze’s MES disclosure would be relevant to the invention)

(citing 1342 Humphrey Decl. ¶ 43; Humphrey Depo., 118:17–120:4; Ex. 1007 ¶ 10 (addressing tool availability calculations using tool state information that is provided by the MES); Ex. 1008, 7:6–21 (describing tool availability information as being related to dynamic operation of the scheduler). There is no persuasive legal authority presented to us for the proposition that Schulze would only be properly considered for its teachings if the specification of the challenged patents identified the presence of the MES as a significant part of the invention, as Patent Owner appears to argue. 1342 Sur-reply 14 (arguing that presence of an MES is not significant and patent describes drawbacks). As stated above with regard to the preamble discussion, Section IV.A–B, the passive nature of the MES is not solved by an improved MES or an MES that is unconventional. Rather, the solution recited in the claim is the addition of software scheduling agents in a computer system so that the system does not rely entirely on WFTs to monitor the state of the factory and react to change. Ex. 1001, 1:65–2:3; 2:12–31, 2:45–3:22, 3:4–7, 3:23–30 (describing WFTs as “agents” that provide the active element lacking in factory control systems). Thus, we are not persuaded that Patent Owner’s characterization of the challenged patents warrant that we discredit Schulze’s teachings.

c) Gupta’s Local Optimization Argument

Patent Owner also argues that the Gupta’s “local optimization” scheme is contrary to the invention and the capabilities of computer systems at the time. 1342 PO Resp. 26–27. According to Patent Owner, Gupta is too simplistic, considering the significant obstacles that stood in the way of realizing scheduling for a complex fab-wide operation. *Id.* Patent Owner further characterizes Dr. Shanfield as admitting that solving scheduling

problems in 2002 were NP-hard problems, practically impossible. *Id.* (citing 1342 Shanfield Decl. ¶ 114).

Petitioner responds that Dr. Shanfield’s testimony is the opposite of how Patent Owner characterizes Gupta and the usefulness of the disclosed “local optimization” scheme. 1342 Reply 15–16. We agree with Petitioner. Schulze describes a large and complex manufacturing facility. 1342 Shanfield Decl. ¶ 114. The problems associated with scheduling globally for a factory of that size were well-known. *Id.* (citing factual support, Exhibits 1014 and 1012, for the stated proposition that such a wide-scale scheduling would have been computationally expensive). However, Dr. Shanfield’s testifies, and we agree, that the local optimization of Gupta is precisely the type of scheduling that would be suitable for solving the known problems with scheduling in a Schulze factory. 1342 Reply 15–16; 1342 Shanfield Decl. ¶¶ 116–17; 1342 Pet. 35. The scheduling problem is simplified by making scheduling decisions on a machine-by-machine basis such that “a single moderately powerful processor can easily handle all the computational demands of a large, complex manufacturing facility.” Ex. 1008, 14:8–11, 2:48–52; 1342 Shanfield Decl. ¶¶ 117–118; 1342 Pet. 36. That is, Gupta is able to make real-time scheduling decisions without resorting to computationally extensive computer systems and programs. Thus, Patent Owner does not persuade us that a person of ordinary skill in the art would not have known how to implement Gupta or to solve “large fab-wide integrated reactive scheduling issues,” as argued. 1342 PO Resp. 27 (citing Humphrey Decl. ¶ 79). Patent Owner’s reliance on Mr. Humphrey’s testimony for this proposition ignores that the claim language does not require “large fab-wide” reactive scheduling. *See supra*

Section IV.D.2. And Mr. Humphrey’s testimony lacks factual support showing what aspect of Gupta’s local scheduling scheme would not be implementable in Schulze’s factory.

Rather, the evidence supports the opposite of what Patent Owner argues. Gupta specifically divides the computational load into specifying the global parameters for the entire factory process flow and then making scheduling decisions for specific machines affected by changes of state information. Ex. 1008, 2:33–54. Only when there is a major change in the process flow or machine availability does Gupta spend computational resources to calculate global parameters, thereby minimizing the computational cost of scheduling for an entire factory. *Id.*; *see also* Ex. 1008, 8:48–55, 13:22–34; 13:43–48; 14:6–11.

Petitioner also proffers Dr. Shanfield’s testimony that it would be fairly straightforward to implement Gupta’s local optimization scheme (with the scheduler) in Schulze’s environment. 1342 Pet. 38; 1342 Reply 17; 1342 Shanfield Decl. ¶¶ 122–129. Patent Owner challenges this testimony as trivializing the complexity of the issue. 1342 PO Resp. 29 (stating that it trivializes the “Herculean step of moving from simply monitoring individual tool status and localized processing . . .”). According to Patent Owner, Dr. Shanfield’s testimony could not be corroborated with explicit disclosure in either Schulze or Gupta indicating the desirability of integrating the two systems. 1342 Sur-reply 16 (citing Shanfield Depo., 42:9–46:4). We are not persuaded by Patent Owner’s arguments.

Dr. Shanfield provides a comprehensive explanation of the reasoning why a person of ordinary skill in the art would have been motivated to look to the local optimization scheme of Gupta. 1342 Shanfield Decl. ¶ 114–121.

Dr. Shanfield also provides explanation of why a person of ordinary skill in the art would have had reasonable expectation of success of combining the teachings of Schulze and Gupta. *Id.* ¶¶ 122–129.

To summarize the testimony, Schulze provides the automated monitoring and assessment system that is suitable for implementing the local scheduler and related data structures disclosed in Gupta, which is implemented in software. *Id.* ¶ 125. The need for a scheduler that works as a local optimizer is evidenced by the recognition in Gupta’s disclosure of real-time scheduling decisions, which are advantageous for dealing with unexpected or unplanned events in a manufacturing process. *Id.* ¶ 121 (citing Ex. 1008, 30:19–20). Further, the local optimization scheme would have been desirable for devising scheduling strategies for specific machines, resulting in a reduction of re-engineering efforts each time a new machine is added to the process flow. *Id.* ¶ 119. Because Gupta focuses on a specific machine and the strategy devised for each machine, the decision-making is simplified as it focuses on optimizing each machine and not re-programming the entire process flow for the factory. *Id.* ¶¶ 116–118. As stated above, the enhancement of using Gupta’s local optimizer stems from the recognition that global process flow scheduling was an NP-hard program of extensive computing costs; yet, Gupta solved for it by reducing the computational costs of scheduling through optimizing local machines, rather than performing global factory calculations each time an event occurs. *Id.* ¶¶ 114–116; Ex. 1008, 8:48–55, 13:22–34; 13:43–48; 14:6–11. The testimony of Dr. Shanfield is persuasive and supported by the facts, and we credit it accordingly.

The record also persuasively shows that the testimony of Dr. Shanfield regarding the expectation of success is supported by the facts and we credit it accordingly. Dr. Shanfield opines that Schulze's system is specifically designed to monitor the state of the equipment and to provide notification of events like machine operation status transitions. 1342 Shanfield Decl. ¶ 123. Gupta's local optimization scheme is driven by events like those that Schulze captures. *Id.* Gupta provides additional events that are useful for Schulze's factory, such as machine loads and unloads. *Id.* Thus, we agree that Schulze's system is particularly suitable for Gupta's local optimization scheme. And according to Dr. Shanfield, the implementation of Gupta's scheduler (together with its database and its related data structures) would be suitable for implementation in the computer of Schulze (automated monitoring and assessment system 107) because they are both software compatible. *Id.* ¶¶ 124–125. Once Gupta's scheduler is implemented in Schulze's computer, there are no changes to the functions performed by Schulze's semiconductor fabrication system or Gupta's local optimization scheme. *Id.* ¶ 127. The implementation would require adjustments to the local scheduler program, so that it can interpret and interact with the messages generated by the equipment and MES of Schulze. *Id.* However, Dr. Shanfield testifies that, “[b]ased on my industry experience, such routine adjustments to the local scheduler software involve tasks like making one-time inputs identifying status flags for each equipment module being characterized, and are well within the ordinary skill of a POSA.” *Id.* None of these tasks would have required special techniques or extraordinary skill given the well-known components and standards used in the Schulze and Gupta implementations. *Id.* ¶ 128.

The above-summarized testimony of Dr. Shanfield persuasively establishes that the implementation of Gupta's local optimization scheme in Schulze's system requires little more than recognizing that Gupta's technique of local optimization improves the monitoring and assessment of machine utilization, to minimize downtime, while avoiding the extensive computational costs of a scheduling function for an entire semiconductor manufacturing facility. And as such, a person of ordinary skill in the art would have recognized that applying Gupta's teachings to Schulze's system as an obvious improvement given that the implementation is not beyond the person's skill. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007).

Patent Owner's arguments to the contrary are not persuasive. There is no requirement for the evidence of a motivation to combine to be explicitly disclosed in either Schulze or Gupta. *See Ruiz v. A.B. Chance Co.*, 357 F.3d 1270, 1276 (Fed. Cir. 2004) (there is no requirement that an "express, written motivation to combine must appear in prior art references before a finding of obviousness."). Furthermore, Patent Owner's assertions that there are technical obstacles or that it is a Herculean task to do advanced comprehensive scheduling ignore the precise combination of teachings asserted by Petitioner. Patent Owner unpersuasively focuses on global scheduling, which is not what either Gupta's scheduler or the challenged claims are directed to. *See supra* Section IV.D.2 (discussing that "software scheduling agent" term does not require global or fab-wide reactive scheduling).

We determine therefore, that Petitioner has shown by a preponderance of the evidence that the teachings of Schulze and Gupta would have resulted in the local optimization implemented in Schulze with a reasonable expectation of success and that the resulting scheduler would automatically

receive notifications from the detected events. 1342 Pet. 43–45; 1342 Shanfield Decl. ¶¶ 113–129, 137. The implemented local scheduler of Gupta would receive automatic notification events detected by Schulze’s MES via the system bus. 1342 Shanfield Decl. ¶ 137. Once detected, the MES would transmit the event over the system bus via one of the predefined messages available to it. *Id.*; Ex. 1007 ¶¶ 40–42. The local scheduler of Gupta would receive the message and the notification of the detected event from the MES or the equipment and respond to the event on a real-time basis. 1342 Shanfield Decl. ¶ 137; Ex. 1007 ¶¶ 41–42; Ex. 1008, 2:51. We credit Dr. Shanfield’s testimony on this issue and find that Petitioner shows by a preponderance of the evidence that a person of ordinary skill in the art would have combined the references to achieve the “automatically notifying” limitation.

3. *“reactively scheduling an action from the software scheduling agent responsive to the detection of the predetermined event” (“reactively scheduling” limitation)*

Petitioner asserts that Gupta’s scheduler, implemented as stated above in Schulze’s automated monitoring and assessment system, performs a “local optimization” to reactively schedule an action to be performed by a machine. Pet. 45–46 (citing Ex. 1008, 13:56–60, 15:49–54, 19:5–44, 22:57–63, 23:34–51; Shanfield Decl. ¶¶ 139–140). For instance, Petitioner points out Gupta’s disclosure that Gupta receives a notification that a machine just unloaded 2 out of 4 lots in its queue, and that based on that event, Gupta’s scheduler performs local optimization to decide “whether to load those 2 lots now, or to wait some short period of time until 1 or 2 more lots arrive so that a larger load can be processed.” Pet. 46 (citing Ex. 1008, 15:49–54; Shanfield Decl. ¶ 140). Petitioner proffers additional examples of

actions scheduled by Gupta's scheduler in response to notifications from a machine. *Id.* (explaining how Gupta's scheduler revises the upstream processing schedule in response to a machine coming online after a repair and how Gupta's scheduler may delay the upstream machine upon notification of a machine's breakage).

Patent Owner contends that Gupta does not teach the "software scheduling agent." 1342 PO Resp. 16–22. According to Patent Owner, Gupta is limited to local machine scheduling. *Id.* (citing 1342 Humphrey Decl. ¶ 50). In Patent Owner's estimation, Gupta's real-time scheduling is not comprehensive enough to perform resource scheduling on a global (fab-wide, distributed optimization) basis. *Id.* at 17 (citing 1342 Humphrey Decl. ¶ 52). In other words, Gupta's scheduler lacks "resource scheduling" (an alleged fundamental aspect of the invention) on a fab-wide scale. *Id.* Patent Owner relies on Mr. Humphrey's testimony that computational limitations in 1988, the date of Gupta, meant that resource scheduling would not be implemented. *Id.* at 19 (citing 1342 Humphrey Decl. ¶ 57). Patent Owner points out that the claimed "software scheduling agents" must coordinate the activities of multiple process tools and that Gupta's scheduler lacks this feature. *Id.* at 20–21.

We are not persuaded by Patent Owner's arguments. As we have determined above, in Section IV.D., the "software scheduling agent" does not require "resource scheduling" or "dynamic, globally reactive scheduling" as argued by Patent Owner. In our analysis of the previous limitation, we also determined that Patent Owner's argument regarding the alleged computational limitations of scheduling did not align with the teachings of Gupta. In other words, Patent Owner's argument that in 1988 computational limitations would have been a significant obstacle to

implementing scheduling as asserted in this proceeding is not persuasive. Gupta provides a solution for scheduling using “a single moderately powerful processor that can easily handle all the computational demands of a large, complex manufacturing facility.” Ex. 1008, 14:8–11. Thus, arguments to the contrary belie persuasive evidence of record.

Furthermore, we have construed the term “software scheduling agent” as “a software agent that at least schedules activities on behalf of a single manufacturing domain entity at any given time.” There is no requirement that the software agent perform computation on a fab-wide scale or a global factory basis according to our analysis of the claim language. *See supra* Section IV.D.2. In Petitioner’s proposed combination, the Gupta local scheduler would be software installed in the automated monitoring and assessment system of Schulze (a computer). 1342 Pet. 43–44 (identifying the local scheduler as the “software scheduling agent” implemented in Schulze’s computer); *see also* Ex. 1008, Appendix A (listing software code). The local scheduler of Gupta schedules activities on behalf of a single manufacturing domain entity at any given time because it schedules an action to be performed by the machine when there is a change of state. 1342 Pet. 45–46 (describing “local optimization” as including scheduling an action to be performed by a machine and providing examples of those actions, such as to load lots now or to send upstream signals based on the needs or status of the current machine); *see also* Ex. 1008, 13:56–60; 19:5–44; 23:34–51; 1342 Shanfield Decl. ¶ 141. Accordingly, we find that Gupta’s local scheduler performing “local optimization” meets the recited “software scheduling agent.”

Finally, we address Patent Owner’s argument that Gupta employs a six-minute interval of computation that would be incompatible with an “integrated fab-wide system for reactive scheduling” as disclosed in the challenged patents. 1342 PO Resp. 28 (citing 1342 Humphrey Decl. ¶ 82). According to Patent Owner, the scheduling of multiple machines and operations simultaneously in a large semiconductor production using Gupta’s six-minute time intervals would not work—it would result in inherent and unavoidable inefficiencies and increased risk of misprocessing. *Id.* Patent Owner faults Petitioner’s analysis as ignoring the technical obstacles presented by the six-minute time steps. 1342 Sur-reply 16 (citing 1342 Humphrey Decl. ¶ 82).

We are not persuaded by Patent Owner’s argument. Gupta describes making scheduling decisions on a real-time basis and Petitioner has described in detail how the Gupta scheduler would be automatically notified of the events and would schedule for the appropriate machine accordingly. 1342 Shanfield Decl. ¶ 137; Ex. 1007 ¶¶ 41–42; Ex. 1008, 2:51. For instance, Petitioner asserts, and we agree, that Gupta discloses receiving a notification that a machine just unloaded 2 of the 4 slots in its queue and the local scheduler performs a local optimization to decide “whether to load those 2 lots now, or to wait some short period of time until 1 or 2 more lots arrive so that a larger load can be processed.” 1342 Pet. 46; Ex. 1008, 15:49–54; 1342 Shanfield Decl. ¶ 140. The six-minute time interval of Gupta’s predictive algorithm does not change the disclosure that Gupta makes decisions in real-time as it is notified of events in the manufacturing process and determining an action to take.

As we stated previously in our Decision on Institution (1342 Dec. on Inst. 13–14), Gupta’s decision-making is event-driven. Ex. 1008, 13:54–60. That decision-making process includes making predictions in advance, when computational resources are expected to be scarce. *Id.* at 14:21–25, 16:4–7. And it also includes making a local prediction or simulation in real time, such as when the machine receives a demand signal. *Id.* at 19:45–59. That Gupta uses the word “prediction” to refer to the calculations it performs in response to an event does not contradict the “reactive scheduling” that Gupta performs. Gupta’s “prediction” refers to calculations that consider the impact of future processing steps that may affect the local machine. *See id.* at 20:5–14. The local prediction process “consists of asking the upstream processes what they will be doing in that time frame,[a few tens of time steps away,] and applying the decision making process to the results.” *Id.* at 20:15–20. In the case of events that are unpredicted, such as machine breakdowns, the calculations must be repeated upon receiving a demand signal. *Id.* at 20:22–27. Thus, we find that Gupta’s local prediction refers to obtaining and analyzing the data needed to calculate which action to take. The word “prediction” in Gupta alludes to the nature of the data analysis, being future-focused, such as tabulating what each machine is in the process of handling and the expected queue. *See, e.g., id.* at 22:3–26, Table 5 (describing the local prediction process for multi-lot machine optimization, which applies lot function minimization to the predicted lot and processing time for the machine).

But when Gupta refers to determining what actions to take, it does so “reactively,” by responding to the events occurring in the machine, like the challenged patents. *See* Ex. 1001, 7:35–37 (explaining that activities

scheduled “reactively” are scheduled “in response to events occurring in, e.g., the process flow 100, in accordance with the present invention”). For example, Gupta explains that when a machine M1 is down, process P37 sends a negative request signal to P36 using a routine that places the negative request signal in the data structures for the upstream processes. Ex. 1008, 24:6–16; *see also* Pet. 46 (citing Ex. 1008, 23:34–51, describing the negative request signal sent upstream to delay the original schedule for a certain amount of time). Thus, Gupta’s prediction analysis that makes use of six-minute intervals to anticipate each machine’s operation is distinct from the reactive actions Gupta takes, such as executing a routine to distribute negative request signals upstream. These are reactive because they are taken in response to the real-time events occurring in the machines, notwithstanding the six-minute interval that Gupta uses for its predictive analysis of the machine’s actions for the near future.

Furthermore, it is not persuasive to argue that Gupta would not work in a large semiconductor production environment simply because of the six-minute interval for predictive analysis. 1342 PO Resp. 28. We do not credit the testimony of Mr. Humphrey’s in this regard. 1342 Humphrey Decl.

¶¶ 79–82. That testimony relies on a distortion of Gupta’s disclosure of how Gupta predicts the decisions for a machine. Ex. 1008, 14:33–40. Gupta states that,

For example, if the decision making process for an average machine is 30 seconds, and 12 machines are due to be unloaded at the same time step, an instantaneous demand of 6 minutes of computation will be required at that time. If this delay is unacceptable, it will be necessary for the scheduling system to begin the decision making calculations 6 minutes in advance.

Id. This passage describes how Gupta determines when to begin calculating the *upcoming* decisions for each machine, in anticipation of the actions machines will take given their workload and far enough in advance to avoid unnecessary delay. If there are 12 machines unloading within a certain time interval, and it takes 30 seconds to compute the actions for the machine, the scheduler will take 6 minutes of computation time ahead of when the machines will unload to avoid the delay. This is not stating that Gupta de facto makes all decisions six-minutes after an event occurs.

Mr. Humphrey's reliance on this passage to assert an incompatibility due to six-minute intervals for the scheduling of individual machines is unsupported by Gupta. Indeed, we understand Gupta as stating the opposite. Gupta's passage, read in context with how Gupta describes its optimization scheme, provides an advance calculation of simultaneous operations of various machines in order to avoid the inefficiencies that Patent Owner alleges would occur with Gupta's local optimization scheme. *See* 1342 PO Resp. 28 (arguing "resource inefficiencies and increased risks for misprocessing," relying on 1342 Humphrey Decl. ¶ 82).

In addition to the above, Mr. Humphrey opines that Gupta's scheduler has a limitation of "real time" scheduling restricted to time steps lasting six minutes merely because Gupta discloses the following,

The period of time which will be used herein is called the time step. A time step is preferably 0.1 hours, or 6 minutes. All times used by the scheduler are expressed in time steps, and all absolute times, such as the predicted time for an event, are expressed as a number of time steps from some arbitrary beginning.

1342 Humphrey Decl. ¶ 80; 1342 PO Resp. 27; Ex. 1008, 3:67–4:4. Gupta describes that the "predicted time for an event" is an absolute time that the scheduler expresses in a time interval lasting 6 minutes. This passage refers

to the local prediction that Gupta performs. According to Gupta, “each machine looks at its short[-]term future, and decides what will happen based on incoming lots and its one decision process.” Ex. 1008, 20:5–8. “When a machine must undertake local optimization, it runs a local simulation to determine what the future will bring.” *Id.* 20:12–14. There is no delay implied here in using the six-minute time interval. The predictions are of events happening in the short-term future. Notwithstanding the prediction time steps described above, Gupta consistently describes how it performs “real time” decision making. Ex. 1008, code (54), 2:51–52, 13:35–44, 14:12–16, 30:3–12, 30:19–20. In the event of a broken machine, for example, the machine’s expected available time is calculated from past statistical behavior and the scheduler sends a signal to upstream processes to adjust the schedule of future-arriving lots, given the delay. *Id.* 23:45–24:16; *see also* Pet. 46 (citing the example of upstream signal requests when machine is offline causing the original schedule to be delayed for a certain amount of time). The signal is an absolute value of a time slot by which lots are needed and this value is placed in the data structure of the upstream process. *Id.* at 23:36–40, 24:8–16. This is a real-time reaction to the event of a machine broken down. The upstream machines may perform a prediction based on the newly updated data structure with the new values received; but Gupta describes that preferably a signal to adjust upstream workloads would not cause a change in the current operation of the upstream process. *Id.* at 24:52–60. That is, other than adjusting the future schedule of the current machine that is off-line, there is no idleness or delay of the other affected processes. This description is at odds with Patent Owner’s contention that a six-minute time step for Gupta’s prediction would mean

that “real time” is either not dynamic enough or that it is too restrictive to work in a large, complex manufacturing facility.²¹ Consequently, we are not persuaded by Patent Owner’s argument that the six-minute time step in Gupta restricts “real time” to such extent that a person of ordinary skill in the art would not turn to Gupta’s scheduler to combine it with Schulze’s system and achieve “reactively scheduling” as claimed.

Finally, we consider Patent Owner’s argument that the ’248 patent provides a basis by which to determine that Gupta’s six-minute interval would present “technical obstacles.” 1342 Sur-reply 16. The argument relies on Patent Owner’s characterization of the ’248 patent as disclosing “additional software components created by agents to keep track of events with the process flow, and calendars for individual agents.” *Id.* (citing Ex. 1001, 7:17–67; 9:23–59). The passages that Patent Owner relies on describe the listeners that are associated with the software agents and the calendar for the particular agent. Ex. 1001, 7:17–67; 9:23–59. It is unclear why these disclosures show that there is an incompatibility with Gupta’s local scheduler. Neither of these listeners or calendars are recited or required by the language of the independent claims. Nor has Patent Owner shown that the ’248 patent disclosures of listeners or calendars alter the functionality of the “software scheduling agent” beyond scheduling. *See supra* Section IV.D.2–3 (discussing that there is no requirement in the claim

²¹ We note that in our Decision on Institution we gave notice to Patent Owner of our understanding of Gupta’s description of “reactively scheduling” in these examples of a machine down in light of the argument that Gupta appears to be predictive and that its six-minute time steps proved slow. *See* Dec. on Inst. 14–15. Patent Owner did not rebut our understanding or provided an interpretation of these passages contrary to our understanding.

construction of “software scheduling agent” performing additional functionality). Furthermore, Gupta also uses a calendar mechanism.

Ex. 1008, 25:57–28:40. And the implementation of listeners in the alleged combination is proffered by Petitioner as being taught by Schulze’s “low-level driver” (*see, e.g.*, 1342 Pet. 53 (describing that each equipment 115 of Schulze includes a “low-level driver” (i.e., a plurality of publishers)) that receives indication of a detected event and publishes a message containing the event information over system bus 105 (*see* Ex. 1007 ¶ 41 (stating that the automated monitoring and assessment system preferably “subscribes” to the information needed))). Accordingly, we find unpersuasive Patent Owner’s alleged support for the argument of technical obstacles presented by Gupta’s local optimization (and in particular, the six-minute time steps).

We determine, based on the examples provided by Petitioner and the arguments presented on a full record that the combination of Schulze and Gupta teaches the “reactively scheduling” limitation. 1342 Pet. 45–46 (citing 1342 Shanfield Decl. ¶¶ 139–141; Ex. 1008, 13:56–60 (describing machine loads, unloads, coming online and going off-line), 15:49–54, 19:5–44, 22:57–63, 23:34–51, cols. 40, 71, 72). According to Petitioner, and we agree, the operational efficiency of the semiconductor fabrication system disclosed in Schulze would be enhanced by the Gupta local scheduler’s dynamic rescheduling functionality without draining the computational resources or causing unacceptable delays. 1342 Pet. 46; 1342 Shanfield Decl. ¶ 142.

Consequently, we determine that Petitioner has shown by a preponderance of the evidence that the combination of Schulze and Gupta teaches the “reactively scheduling” limitation.

4. Conclusion Regarding Claim 1 of the '248 Patent

On the full record, we determine that Petitioner has shown by a preponderance of the evidence that claim 1 would have been unpatentable as obvious over Schulze and Gupta.

D. Independent Claim 14 of the '248 Patent

Claim 14 recites substantively similar limitations to those recited in claim 1, except that claim 14 is an apparatus claim that requires “a plurality of scheduling agents” residing on a “computer system,” “scheduling appointments for activities in the process flow,” and “notification of a plurality of events.” Ex. 1001, 32:6–11.

1. Plurality of Scheduling Agents

Petitioner relies on the same combination of teachings of Schulze and Gupta, and further explains that “it would have been obvious to a [person of ordinary skill in the art] to implement different local schedulers for different types of machines in the process flow.” 1342 Pet. 49 (citing 1342 Shanfield Decl. ¶ 147). In support, Petitioner cites Gupta: “[t]he local optimization process for the bottleneck machines may need to be different from that of other machines.” *Id.* (citing Ex. 1008, 10:12–16) (alteration in original). According to Petitioner, because a local scheduler represents one machine or tool during a local optimization process, “a [person of ordinary skill in the art] would have found it obvious to implement a plurality of local schedulers performing parallel processing.” *Id.* (citing Shanfield Decl. ¶ 148). According to Dr. Shanfield, such a parallel processing structure of a plurality of local schedulers would shorten delays and increase scheduling efficiency. Shanfield Decl. ¶ 148.

Patent Owner argues claim 14 together with claim 1, presenting the same arguments discussed already. For instance, Patent Owner notes that

claim 14 includes the limitation “software scheduling agents being capable of reactively scheduling appointments for activities in the process flow” to argue that a person of ordinary skill in the art would not have found Schulze relevant to the claimed invention of the ’248 patent, the same argument presented for claim 1. 1342 PO Resp. 15 (including this argument in the section that Schulze does not disclose the software scheduling agents).

These arguments were addressed *supra* in Section V.C.2. Likewise, Patent Owner argues that similarly to claim 1, claim 14 recites “reactively scheduling appointments in the process flow” and that neither Schulze nor Gupta teaches the “integrated, automated process flow.” 1342 PO Resp. 24, 25. We addressed these arguments *supra* in Section V.C.1. Patent Owner also argues “reactively scheduling” as recited in claim 14 together with claim 1. 1342 PO Resp. 25 (addressing limitations 1.c. and 14.c. together). We addressed these arguments *supra* in Section V.C.3.

As for Sur-reply arguments, we note that the issue of whether the preamble is limiting in claim 14 is the same as the argument presented for claim 1 and discussed above. 1342 Sur-reply 2–3; *See supra* Section IV.A–B, V.C. Furthermore, Patent Owner raised a specific argument for claim 14 in the Sur-reply that claim 14 recites “a plurality of software scheduling agents” which would militate finding the claim as reciting “fab-wide reactive scheduling.” 1342 Sur-reply 12–13. According to Patent Owner, the “plurality of software scheduling agents schedules process activities across a semiconductor fab, rather than just for a single tool or wafer.” *Id.* Patent Owner also warns against Gupta scaling up its local optimization to the entire fab “due to the ‘prohibitive computational resources’ required.” *Id.* at 12–13 (citing Ex. 1008, 14:2–5). According to

Patent Owner, Dr. Shanfield acknowledged as much. *Id.* (citing Shanfield Depo 62:6–11). Gupta, Patent Owner argues, can propagate changes to upstream machines with the limited constraints in its scheduler and thus Gupta is limited to one machine and upstream machine, and not capable of fab-wide scheduling in real-time, including resource scheduling. *Id.* at 13.

Patent Owner also faults Dr. Shanfield’s reliance on parallel processing in Gupta stating that he “acknowledged that there is nothing in Schulze or Gupta that discloses *how* the system of Schulze would inform the Gupta scheduler of a bottleneck in the system.” *Id.* at 13–14 (citing 1342 Reply at 15; 1342 Shanfield Decl. ¶¶ 147–49; Shanfield Depo 65:24–66:23).

We are not persuaded by Patent Owner’s arguments that it would not have been obvious to combine the teachings of Gupta and Schulze to teach the limitation of a “plurality of software scheduling agents.” First, we have determined that there is no requirement of either *fab-wide* or *globally* reactive scheduling by the recitation of the “plurality of software scheduling agents” in claim 14. *See supra* Section IV.D.2. Thus, it is not persuasive to argue that claim 14 requires fab-wide or global scheduling and that Gupta lacks this feature (or that it does not update upstream machines “globally”).

In any event, Petitioner is relying on an obvious modification of Gupta—to implement additional local schedulers to account for the different types of machines. 1342 Pet. 49. According to Petitioner, Gupta already makes a distinction between different types of machines with different optimization schemes, such as a bottleneck machine, that may be optimized differently than other machines in the process flow. *Id.* (citing Ex. 1008, 10:12–16; 1342 Shanfield Decl. ¶ 147). According to Dr. Shanfield, the bottleneck machine implementation in Gupta likely involves a local

optimization process already. 1342 Shanfield Decl. ¶ 147 (citing Ex. 1008, 10:18–20). He posits that not all bottleneck machines have the same usage and degree of criticality and, therefore, a person of ordinary skill in the art would have been motivated to implement a plurality of specialized local schedulers for the bottleneck machines separate from other machines. *Id.* These would have been implemented as local schedulers performing parallel processing. *Id.* ¶ 148 (citing Ex. 1025, 225, 232). Parallel processing would have been understood as shortening delays caused by scheduling, and increasing scheduling efficiency. *Id.* Other benefits of parallel processing would have been recognized as well, including alleviating strain on processing power caused by sudden spikes in scheduling demand, such as multiple machines loading at the same time. *Id.* (citing Ex. 1008, 14:12–16, 12:30–40).

Thus, Petitioner’s position is that a person of ordinary skill in the art would have implemented more than one Gupta local scheduler, and, more specifically, would have implemented an additional local scheduler for a bottleneck machine given Gupta’s teachings that those machines have different optimization needs. The reasoning, as described above, is compelling and supported by Gupta’s description as cited above regarding the operation of the bottleneck machines. The concept of parallel processing and its benefits are corroborated with factual support. For instance, Dr. Shanfield relies on evidence of the knowledge of a person of ordinary skill that a parallel processing model is especially adaptable to manufacturing system to simulate physical flows. Ex. 1024, 225; *see also id.* at 232 (explaining that parallel processing can greatly reduce computation time and that a factory in which each machine and support

equipment processes raw materials is already a parallel system). The testimony of Dr. Shanfield is therefore adequately supported by the record and we credit it accordingly. Patent Owner does not address this evidence—and other than characterize Gupta as a “single tool” implementation, it does not challenge the evidence proffered by Petitioner supporting Gupta’s modification and the benefits of parallel processing by local schedulers.

Second, the argument that Gupta cannot be scaled up is unsupported by the evidence of record. Patent Owner mischaracterizes the testimony of Dr. Shanfield as somehow supporting the proposition that Gupta lacks computational resources. The testimony at page 62 of Dr. Shanfield’s deposition describes what Gupta already describes—that to perform global computations for an ever-changing schedule is computationally expensive. Shanfield Depo., 62:6–11. In context, Dr. Shanfield explains that Gupta simplifies this problem and proposes a way to reduce computational resources to optimize the schedule accordingly. *Id.* 62:12–22. We note here also that Gupta describes “global planning” and “local optimization” for the entire fab. Ex. 1006, 8:46–9:21, 13:41–14:26. Thus, arguing that Gupta’s scheduler would not be focused on an entire fab is belied by Gupta’s disclosure. Further, the portions of Gupta that Patent Owner relies on (Ex. 1008, 14:2–5) do not support what Patent Owner asserts—that “Gupta expressly warns against scaling up its local optimization to the entire fab due to the ‘prohibitive computational resources’ required.” 1342 Sur-reply 12. Rather, we find that Gupta teaches a system design that makes a large number of simple computational decisions *for each machine of the entire factory*, rather than a computation heavy design that requires recalculating the global parameters for the entire factory each time a decision is made.

Ex. 1008, 13:67–14:11. Patent Owner’s argument of Gupta’s local scheduling being unable to work at the factory level (as opposed to a single tool) is unpersuasive.

Finally, we address Patent Owner’s argument that Dr. Shanfield’s testimony shows that neither Schulze nor Gupta “discloses *how* the system of Schulze would inform the Gupta scheduler of a bottleneck in the system.” 1342 Sur-reply 14 (citing Shanfield Depo., 65:24–66:23). The testimony does not support Patent Owner’s assertion. Dr. Shanfield testifies that Schulze’s automated monitoring and assessment system would have Gupta’s scheduling agent and this agent would optimize the scheduling for the bottleneck system. Shanfield Depo., 65:2–13. Referring to Gupta’s scheduler for the bottleneck system, Dr. Shanfield was asked: “How does it know which one is the bottleneck piece of equipment?” *Id.* at 66:1–2. Dr. Shanfield responded that the scheduler is “set up to address the bottleneck. The bottleneck is well known. It’s calculable.” *Id.* at 66:3–4. Subsequent questioning focused on whether the metrics for the calculation would be disclosed by Gupta’s paragraph 17. *Id.* at 66:5–7. But upon attempting to restate the question (likely causing confusion because there is no paragraph 17 in Gupta) counsel changed the question to focus on whether the calculation of the bottleneck would be done in the logic described in “paragraph 117.” *Id.* at 66:13–16. Dr. Shanfield unequivocally stated that the question was very broad and that “the information Schulze’s system supplies would be sufficient to figure out where the bottleneck was.” *Id.* at 66:20–23. This is a different line of questioning than what Patent Owner asserts Dr. Shanfield admitted. He answered a question about whether logic in Gupta would calculate where the bottleneck machine would be; yet Patent

Owner argues that the testimony admits something different—that nothing shows *how* Schulze would inform Gupta of the bottleneck. The questioning at best relates to how the scheduler would know of the bottleneck, which Dr. Shanfield opined would be calculable by Gupta’s scheduler. In any event, we are persuaded that Dr. Shanfield had already answered the questions of *how* the Schulze and Gupta combination would detect equipment that is down and optimize the schedule for that equipment. Shanfield Depo., 31:11–33:11 (describing that the equipment 115 sends a standard protocol signal with its status as “down” and the automated monitoring and assessment system queries the MES and detects the current status of equipment 115, and then if there is a trigger, it takes effect), 35:3–19 (explaining that with the combination of teachings the scheduler will establish a local schedule for the equipment with the new state information that it is not operational); *see also* 1342 Shanfield Decl. ¶¶ 123–126; 1342 Pet. 38–39. Given the record before us, including the testimony of Dr. Shanfield regarding how the asserted combination of teachings would operate, we reject Patent Owner’s contention that testimonial excerpts of Dr. Shanfield, presented out of context by Patent Owner, show insufficiency of evidence for *how* the system of Schulze would inform the Gupta scheduler of a bottleneck in the system.

2. *Notification of a Plurality of Predetermined Events and Scheduling Appointments for Activities in the Process Flow*

As for further limitations that claim 14 recites not already discussed with respect to claim 1, the Petition identifies that Gupta discloses detection and notification of a plurality of predetermined events and the scheduling of appointments for activities, as required by the claim. 1342 Pet. 50–51. For instance, Petitioner points to Gupta’s disclosure of various events such as

“machine loads and unloads, and a machine going off-line or coming on-line.” Ex. 1008, 1:30, 2:48–52, 16:20–29.

As for scheduling of appointments as required by the claim, Petitioner points to Gupta’s disclosure of a calendaring system for storing information on upcoming events, such as machine loads and unloads. 1342 Pet. 50–51 (citing Ex. 1008, 25:60–64, 27:33–35). Specifically, Gupta describes a machine data structure indicating when it next expected to load and when the machine next unloads, and as such it discloses the beginning and end of an appointment. Ex. 1008, 14:16–19; 1342 Shanfield Decl. ¶ 151. As an example, according to Petitioner, and we agree, Gupta’s local scheduler implemented in Schulze’s system, would reactively schedule appointments for the activities such as a machine’s partial unloading and decide whether the machine would wait. 1342 Pet. 51 (citing Ex. 1008, 15:49–54; 1342 Shanfield Decl. ¶ 152). As another example, Petitioner points out that the local scheduler for a broken machine could place a time stamp in an upstream machine’s data structure, which delays the upstream machine’s processing appointment. *Id.* (citing Ex. 1008, 23:34–51; 1342 Shanfield Decl. ¶ 152).

We are persuaded that the evidence presented and discussed above show that the further limitations of claim 14 have been sufficiently disclosed by Gupta. Patent Owner does not present argument particular to these further limitations of claim 14.

3. Conclusion Regarding Claim 14 of the ’248 Patent

For the same reasons as stated in Section V.C. (with respect to claim 1 of the ’248 patent) and as described above regarding the “plurality of software scheduling agents” limitation and persuasive reasons for the

obvious combination of teachings, we determine that Petitioner has shown by a preponderance of the evidence that claim 14 would have been unpatentable as obvious over the combination of Schulze and Gupta.

E. Challenged Dependent Claims of the '248 Patent

Petitioner has provided a mapping of the further limitations, together with evidence supporting the obviousness challenge of dependent claims 2–13 and 15–22 of the '248 patent. Pet. 51–67. Patent Owner does not argue any of these claims separately. *See* 1342 PO Resp. 31–32. For the reasons that follow, we determine that Petitioner has shown by a preponderance of the evidence that all the challenged dependent claims would have been unpatentable as obvious over Schulze and Gupta.

1. Dependent Claims 6, 15, and 18

Claims 6, 15, and 18 recite “publishers” and “subscribers” or “subscribing listener.” Petitioner asserts that each equipment 115 in Schulze includes a “low-level driver,” which constitutes the required “publisher” because this driver receives the indication of a detected event and publishes a message that contains the event information over system bus 105. Pet. 52–53 (citing Ex. 1007 ¶¶ 40–42, 46; Shanfield Decl. ¶ 156). Bus controller 109 of Schulze, i.e., the recited “subscriber” or “subscribing listener,” also connected to system bus 105, receives the message published by the driver of equipment 115 and, according to the implemented combination of teachings, the controller calls the local scheduler or “software scheduling agent” by routing some of the information in each message to automated and assessment system 107. *Id.* at 53 (citing Ex. 1007 ¶¶ 40–41; Shanfield Decl. ¶ 156).

We are persuaded that Petitioner has explained how specific teachings would have been combined in light of the disclosures of Gupta and Schulze as explained above. Dr. Shanfield, who we credit in this regard, explains that Schulze's system and controller are already configured to listen to the bus messages and that it would have been obvious to configure the system and controller to further call the local scheduler in response to the received messages. 1342 Shanfield Decl. ¶¶ 156–157. Thus, the record provides sufficient explanation that a person of ordinary skill in the art would have programmed the controller (and the monitoring system) to call or invoke another program, the local scheduler, based on the notification. And we note that “[a] person of ordinary skill is also a person of ordinary creativity, not an automaton.” *KSR*, 550 US at 420.

Having reviewed the language of these claims, the arguments, and evidence presented, we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 6, 15, and 18 would have been unpatentable as obvious over Gupta and Schulze.

2. Dependent Claims 2 and 16

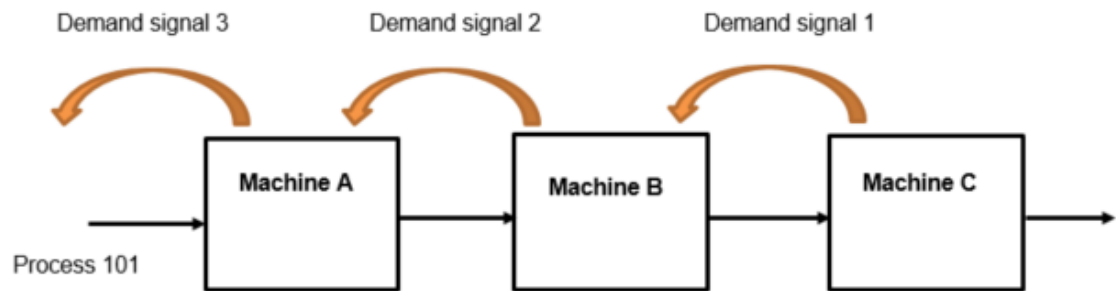
Dependent claims 2 and 16 recite further limitations concerning the detection of an “unplanned event or an unexpected event.” Ex. 1001, 30:49–51; 32:17–20. The Petition points to the combination of teachings of Schulze and Gupta as disclosing this limitation because the combination detects “a broken machine or perhaps even one which has developed a large queue.” 1342 Pet. 56 (citing Ex. 1008, 16:20–29; 1342 Shanfield Decl. ¶ 162). According to Petitioner, and we agree, a person of ordinary skill in the art would have appreciated that the ability to reschedule operations in response to an unexpected or unplanned event is particularly advantageous

in an event-driven and real-time scheduling method of Gupta. *Id.* (citing Ex. 1008, 2:37–39, 30:19–20; 1342 Shanfield Decl. ¶ 162). We are persuaded by a preponderance of the evidence that Petitioner has shown that claims 2 and 16 would have been obvious as unpatentable over Gupta and Schulze.

3. *Dependent Claims 3, 4, and 17*

Dependent claims 3, 4, and 17 further recite detection of an appointment state change. Ex. 1001, 30:52–63, 32:21–24. Claim 4 in particular, recites additional details of the appointment state changes, such as “detecting at least one of . . . a load time update, an unload time update” Ex. 1001, 30:60–61. Petitioner argues that Gupta specifically describes detecting an appointment state change when the machine data structure indicates “when it is next expected to load” and “when that machine will next unload.” 1342 Pet. 57–58 (citing Ex. 1008, 14:16–19; 1342 Shanfield Decl. ¶ 164). According to Petitioner, and we agree, machines in the Schulze-Gupta combination would detect “a load time update” when a request/demand signal is sent as a loading time for the upstream machine. *Id.* (Ex. 1008, 19:5–44, 22:57–63, 23:34–51; 1342 Shanfield Dec. ¶ 165). As another example, Petitioner argues and we agree that machines in the Schulze-Gupta combination would detect an “unload time update” as a negative request or lack of demand signal that is placed in the upstream machine’s data structure. *Id.*; *see also* Ex. 1008, 20:22–27 (if a machine is “the recipient of a demand signal, or a request or negative-request signal[,], and any demands imposed by these signals are not met, they must be passed upstream and the prediction process repeated.”).

Petitioner also provides an illustration, reproduced below, of the upstream flow of signals caused by Gupta's scheduler that informs the various machines of appointment changes. 1342 Pet. 58–59; 1342 Shanfield Decl. ¶ 167.



Petitioner's illustration shows Machines A, B, and C ordered sequentially in "Process 101" where a lot is to be processed by each machine successively. 1342 Pet. 59. Machine B detects "Demand signal 1" issued from Machine C, as an appointment state change requesting it to advance processing of a specific lot. 1342 Shanfield Decl. ¶ 167. However, if Machine B is unable to meet the demand because Machine A is not finished processing the lot, Machine B notifies Machine A of the load time update with "Demand signal 2." *Id.* ¶ 168; Ex. 1008, 20:22–27. The scheduler then performs optimization for Machine A given the received notification, and determines whether to schedule Machine A to process the lot, or to schedule an action for another machine further upstream ("Demand signal 3"). 1342 Shanfield Decl. ¶ 168.

According to Petitioner, this explanation shows, and we agree, that the Schulze-Gupta combination automatically (1) detects, at Machine B, an appointment state change (via the "Demand signal 1" message); (2) automatically notifies the local scheduler of Machine A of the state

change or event; and (3) the local scheduler of Machine A reactively schedules an action in response, such as by either scheduling processing of the current lot or scheduling via a further demand signal an action for an upstream machine.

We are persuaded by the argument and evidence summarized above and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 3, 4, and 17 would have been obvious as unpatentable over Gupta and Schulze.

4. Dependent Claims 10, 11, and 21

Claims 10, 11, and 21 recite the detection of a factory state change. Ex. 1001, 31:37–50; 32:47–50. Petitioner argues and we agree that Gupta discloses a “factory state change” because it describes when machine loads and unloads, machines going off-line or coming on-line, and a broken machine or one that has a large queue. Ex. 1008, 1:30, 2:48–52, 16:20–29. We agree that these are all factory state changes that Gupta detects. 1342 Shanfield Decl. ¶ 172. Accordingly, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 10, 11, and 21 would have been obvious as unpatentable over Gupta and Schulze.

5. Dependent Claims 12, 13, and 22

Claims 12, 13, and 22 all recite the detection of an alarm event. Ex. 1001, 31:51–55-32:02, 32:51–53. According to Petitioner, and we agree, Schulze discloses detection and notification of alarm events in a semiconductor manufacturing process: “Process Start,” “Process End,” “Power Problem,” “Tool Alarm,” and “Tool Alarm Clear.” 1342 Pet. 61–62; Ex. 1007 ¶¶ 170, 210, 211, Fig. 15B; 1342 Shanfield Decl. ¶ 174. Petitioner also posits that a person of ordinary skill in the art would have

been motivated to configure the local scheduler to include one or more of those alarm events as trigger events for the local scheduler. 1342 Shanfield Decl. ¶ 174. The motivation stems from appreciating that doing so would improve the versatility of the local scheduler by expanding the range and type of unexpected and unplanned events the local scheduler could handle.

Id. Furthermore, in connection with the calendaring scheme of the local scheduler, it would have been appreciated that firing an alarm for an appointment start time and appointment end time would enable the local scheduler to respond to unexpected delays and optimize the process further.

Id. ¶ 175. We are persuaded by these explanations of Dr. Shanfield that a person of ordinary skill in the art would have had reason to implement alarms as further events that the local scheduler would detect and respond to accordingly. We credit the unrebutted and reasoned testimony of Dr.

Shanfield in connection with these claims. 1342 Shanfield Decl.

¶¶ 174–176 (noting specifically the implementation of the alarm event in the data structure using the WAITING-TIME parameter in Figure 3 of Gupta.)

Consequently, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 12, 13, and 22 would have been obvious as unpatentable over Gupta and Schulze.

6. *Claim 5*

Claim 5 recites specific examples of appointment state changes, factory state changes, and alarm events recited in claims 4, 11, 13.

Ex. 1001, 30:64–31:14. Petitioner relies on Gupta’s disclosure discussed above with respect to dependent claims 4, 11, and 13. *See* 1342 Pet. 64 (citing Ex. 1008, 1:30, 2:48–52, 16:20–29; 1342 Shanfield Decl. ¶ 179). For the same reasons as stated above with respect to claims 4, 11, and 13, we

determine that Petitioner has demonstrated by a preponderance of the evidence that claim 5 would have been obvious over Gupta and Schulze.

7. Claims 7 and 19

Claims 7 and 19 recite additional limitations relating to reactively scheduling an action. Ex. 1001, 31:23–30, 32:34–43. Petitioner relies on its argument and evidence presented for the limitations concerning the local scheduler is implemented in the automated monitoring and assessment system of Schulze to reactively schedule a shift of a scheduled appointment. 1342 Pet. 65. In particular, Petitioner states that the evidence presented for claim 1 in light of Gupta’s teachings shows that the Schulze-Gupta combination performs, “1) delaying a processing appointment scheduled for the present machine, 2) advancing a processing appointment scheduled for an upstream machine, and 3) delaying a loading appointment scheduled for an upstream machine.” *Id.* (citing Ex. 1008, 19:5–44, 22:57–63, 23:34–51; 1342 Shanfield Decl. ¶ 182); *see also supra* Section V.C.3. We agree with Petitioner’s contention that the evidence of record shows a shift in a scheduled appointment, as explained already that upon notifying the local scheduler of an event, such as a machine down, the local scheduler makes an optimization that results in a shift of the machine’s schedule by delaying the arrival of slots from other machines. Ex. 1008, 23:34–51.

Consequently, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 7 and 19 would have been obvious over Gupta and Schulze.

8. Claims 8, 9, and 20

Claims 8, 9, and 20 further recite proactively scheduling an appointment associated with the predetermined event. Ex. 1001, 31:31–36,

32:44–46. According to Petitioner, and we agree, Gupta’s local scheduler uses a calendar system for scheduling appointments and when the local scheduler expects a heavy demand on its computational resources, it makes scheduling decisions for appointments “ahead of time.” 1342 Pet. 66–67; Ex. 1008, 14:12–42, 25:60–64, 27:33–35; 1342 Shanfield Decl. ¶ 185. We are persuaded by these arguments and the Gupta disclosures of “proactive scheduling” by teaching its optimization “ahead of time.”

Consequently, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 8, 9, and 20 would have been obvious over Gupta and Schulze.

F. Independent Claims 1, 12, and 19 of the ’305 Patent

As already stated, there is significant overlap between claims 1, 12, and 19 of the ’305 patent and claim 1 of the ’248 patent discussed above. For expediency, we refer to the arguments and evidence presented for claim 1, to the extent the parties’ arguments are substantively identical.

1. Preamble

Whether the preamble is limiting in claims 1, 12, and 19 of the ’305 patent has been discussed above in connection with our claim construction analysis. *See supra* Section IV.A (“Whether the preamble is limiting”). *See* 1344 Pet. 40–41; 1344 Reply 3–4; 1344 PO Resp. 8 (listing “automated manufacturing environment” as a limitation not taught for claims 1, 12, 19, and 33); 1344 Sur-reply 2–3. As for the substantive alternative arguments presented by Petitioner that Schulze nevertheless teaches an “automated manufacturing environment,” we adopt here our discussion in Section V.C.

2. *“detecting the occurrence of a predetermined event in a process flow”*

As in the 1342 IPR, Petitioner relies on Schulze for the limitation that recites “detecting an occurrence of a predetermined event in a process flow.” 1344 Pet. 41–42. Patent Owner’s arguments concerning the “process flow” recited in claims 1, 12, and 19 of the ’305 patent are substantively identical to the arguments considered above for claim 1 of the ’248 patent. 1344 PO Resp. 8 (arguing that the “process flow” is automated), 9 (arguing that Schulze makes no mention of an integrated or automated process flow), 24 (arguing the “integrated” aspects of the ’305 patent), 25 (arguing that the “process flow” (qualified as “integrated” despite the lack of that language in the ’305 patent claims) in the context of the ’305 patent must include an AMHS); 1344 Sur-reply 4–7 (arguing that the process flow of claims 1, 12, 19, 33, and 44 includes the AMHS and Schulze fails to teach this).

We adopt our analysis for the corresponding limitation of claim 1 in the ’248 patent discussed above. Section V.C.1. We further note, however, that the claims of the ’305 patent do not recite an “integrated, automated process flow”—rather they recite a “process flow.” Therefore, for this additional reason, any argument concerning the lack in the prior art of “integrated” or “automated” features in the “process flow” are unpersuasive.

3. “*notifying a software scheduling agent of the occurrence*”
 (“notifying” limitation)

Petitioner relies on the same arguments and evidence as identified for claim 1 of the ’248 patent. 1344 Pet. 42–43; 1344 Reply 10–12. Patent Owner responds with the same arguments presented in the 1342 IPR. 1344 PO Resp. 8–21, 26–31; 1344 Sur-reply 7–9, 15–18. We adopt here the same analysis and conclusions stated above with respect to claim 1 of the ’248 patent. *See supra* Section V.C.2.

4. “*reactively scheduling an action from the software scheduling agent responsive to the detection of the predetermined event*”
 (“reactively scheduling” limitation)

Petitioner relies on the same arguments and evidence as identified for claim 1 of the ’248 patent. 1344 Pet. 44–45; 1344 Reply 12–15. Patent Owner responds with the same arguments presented in the 1342 IPR. 1344 PO Resp. 22–25; 1344 Sur-reply 10–13. We adopt here the same analysis and conclusions stated above with respect to claim 1 of the ’248 patent. *See supra* Section V.C.3.

5. *Conclusion Regarding Claims 1, 12, and 19 of the ’305 Patent*

On the full record, we determine that Petitioner has shown by a preponderance of the evidence that claims 1, 12, and 19 of the ’305 patent would have been unpatentable as obvious over Schulze and Gupta.

G. Independent Claims 33 and 44 of the ’305 Patent

Claims 33 and 44 are similar in substance to claim 19, except claims 33 and 44 recite “a plurality of software scheduling agents.” Ex. 1001, 43:46–47, 44:54–55. The claim language for these claims in the ’305 patent track the same language recited in claim 14 of the ’248 patent. *See supra* Section V.D. Claims 33 and 44 also recite “responsive to a plurality of

predetermined events” and “scheduling appointments for activities in the process flow,” which are substantively similar to those recited in claim 14 of the ’248 patent. *Id.*

Petitioner here relies on the same combination of teachings of Schulze and Gupta as for claims 1, 12, and 19, and further explains that “it would have been obvious to a [person of ordinary skill in the art] to implement different local schedulers for different types of machines in the process flow.” 1344 Pet. 47–48 (citing 1344 Shanfield Decl. ¶ 152). In support, Petitioner cites Gupta: “[t]he local optimization process for the bottleneck machines may need to be different from that of other machines.” *Id.* (citing Ex. 1006, 10:12–16). According to Petitioner, because a local scheduler represents one machine or tool during a local optimization process, “a [person of ordinary skill in the art] would have found it obvious to implement a plurality of local schedulers performing parallel processing.” *Id.* at 49 (citing 1344 Shanfield Decl. ¶ 153). According to Dr. Shanfield, such parallel processing structure of a plurality of local schedulers would shorten delays and increase scheduling efficiency. 1344 Shanfield Decl. ¶ 153.

Patent Owner’s arguments presented here are identical to those presented with respect to claim 14 of the ’248 patent. For instance, Patent Owner argues that “fab-wide” reactive scheduling is encompassed by claims 33 and 44 because of the “plurality of software scheduling agents” and that Gupta is not capable of performing such a fab-wide scheduling given computational resources and its disclosure of scheduling for a single tool. 1344 Sur-reply 13–15 (arguing also the lack of support for Dr. Shanfield’s testimony regarding bottlenecks and parallel processing).

We addressed already Patent Owner’s arguments in light of the full record and analyzed Petitioner’s evidence presented for the same limitations recited in claims 33 and 44 of the ’305 patent. We adopt here that analysis in its entirety. Section V.D.

For the same reasons as stated in Section V.C. (with respect to claim 1 of the ’248 patent) and as described in Section V.D.1–3 together with our analysis of the proffered reasons for the obvious combination of teachings, we determine that Petitioner has shown by a preponderance of the evidence that claims 33 and 44 of the ’305 patent would have been unpatentable as obvious over the combination of Schulze and Gupta.

H. Challenged Dependent Claims of the ’305 Patent

Petitioner has provided a mapping of the further recited limitations, together with evidence supporting the obviousness challenge of dependent claims 2–11, 13–18, 20–25, 34–35, and 45–53 of the ’305 patent. 1344 Pet. 51–67. Patent Owner does not argue any of these claims separately. *See* 1344 PO Resp. 32. For the reasons that follow, we determine that Petitioner has shown by a preponderance of the evidence that all the challenged dependent claims would have been unpatentable as obvious over Schulze and Gupta.

1. Claims 8, 16, 23, 34, 38, 45, and 49

Claims 8, 16, 23, 34, 38, 45, and 49 of the ’305 patent recite “publishers” and “subscribing listener.” Petitioner asserts, and we agree, that each equipment 115 in Schulze includes a “low-level driver,” which constitutes the required “publisher” because this driver receives the indication of a detected event and publishes a message that contains the

event information over system bus 105. 1344 Pet. 51–53 (citing Ex. 1007²² ¶¶ 40–42, 46; 1344 Shanfield Decl. ¶ 163). Bus controller 109 of Schulze, i.e., the recited “subscribing listener,” also connected to system bus 105, receives the message published by the driver of equipment 115 and, according to the implemented combination of teachings, the controller calls the local scheduler or “software scheduling agent” by routing some of the information in each message to automated and assessment system 107. *Id.* at 53 (citing Ex. 1007 ¶¶ 40–41; 1344 Shanfield Decl. ¶¶ 163–164).

Furthermore, Petitioner has explained persuasively how specific teachings would have been combined in light of the disclosures of Gupta and Schulze as explained above. 1344 Pet. 51–53 (citing Schulze ¶¶ 40–42, 46; 1344 Shanfield Decl. ¶¶ 163–164). Dr. Shanfield, who’s testimony we credit in this regard, explains that Schulze’s system and controller are already configured to listen to the bus messages and that it would have been obvious to configure the system and controller to further call the local scheduler in response to the received messages. 1344 Shanfield Decl. ¶¶ 163–164. Thus, the record provides persuasive support that a person of ordinary skill in the art would have programmed the controller (and the monitoring system) to call or invoke another program, the local scheduler, based on the notification. And we note that “[a] person of ordinary skill is also a person of ordinary creativity, not an automaton.” *KSR*, 550 US at 420. *See also supra* Section E.1.

²² All citations to Exhibit 1007 refer to the Schulze reference as filed in the 1342 IPR to maintain consistency across proceedings, notwithstanding that the Schulze reference was filed as Exhibit 1005 in the 1344 IPR.

Having reviewed the evidence and arguments presented on a full record, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 8, 16, 23, 34, 38, 45, and 49 of the '305 patent would have been unpatentable as obvious over Gupta and Schulze.

2. Claims 2–7, 13–15, 20–22, 35–37, and 46–48

Petitioner presents the grouping of claims 2–7, 13–15, 20–22, 35–37, 46–48 as reciting additional limitations relating to the “predetermined event.” Ex. 1001, 39:64–40:40, 41:08–33, 42:01–27, 43:56–44:15, 44:64–65; 1344 Pet. 55–64. Petitioner organizes these claims according to the various recited events as follows:

Predetermined Events	Claim(s)
Unplanned/unexplained event	2, 13, 20, 35, 46
Appointment state change	4
Factory state change	5
Alarm event	6
One of an appointment state change, a factory state change, or an alarm event	3, 7, 14, 15, 21, 22, 36, 37, 47, 48

1344 Pet. 55. We analyze each of these groups in turn.

a) Claims 2, 13, 20, 35, and 46

These claims are grouped in the unplanned/unexplained event category. 1344 Pet. 55–56. The claims recite “detecting an unplanned or an unexpected event.” Ex. 1001, 39:61–63, 41:09–11, 42:1–04, 43:56–59, 44:64–67. Petitioner relies on Gupta as disclosing the further recited limitation. The arguments and supporting evidence are substantively identical to those presented for claims 2 and 6 of the '248 patent. *See supra*

Section V.E.2. We adopt here the analysis and conclusion stated above with respect to those claims.

We determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2, 13, 20, 35, and 46 of the '305 patent would have been unpatentable as obvious over Schulze and Gupta.

b) Claim 4

Claim 4 recites examples of “appointment state change.” Ex. 1001, 40:1–9; 1344 Pet. 56–57. The arguments and supporting evidence are substantively identical to those presented for claims 3, 4, and 17 of the '248 patent. *See supra* Section V.E.3. We adopt here the analysis and conclusion stated above with respect to those claims. We determine that Petitioner has demonstrated by a preponderance of the evidence that claim 4 of the '305 patent would have been unpatentable as obvious over Schulze and Gupta.

c) Claim 5

Claim 5 recites examples of “factory state change.” 1001, 40:9–19 1344 Pet. 57–59. The arguments and supporting evidence are substantively identical to those presented for claims 10, 11, and 21 of the '248 patent. *See supra* Section V.E.4. We adopt here the analysis and conclusion stated above with respect to those claims. We determine that Petitioner has demonstrated by a preponderance of the evidence that claim 5 of the '305 patent would have been unpatentable as obvious over Schulze and Gupta.

d) Claim 6

Claim 6 recites examples of an “alarm event.” Ex. 1001, 40:20–23. 1344 Pet. 60–61. The arguments and supporting evidence are substantively

identical to those presented for claims 12, 13, and 22 of the '248 patent. *See supra* Section V.E.5. We adopt here the analysis and conclusion stated above with respect to those claims. We determine that Petitioner has demonstrated by a preponderance of the evidence that claim 6 of the '305 patent would have been unpatentable as obvious over Schulze and Gupta.

e) Claims 3, 7, 14, 15, 21, 22, 36, 37, 47 and 48

Claims 3, 14, 21, 36, and 47 (depending from claims 1, 14, 21, 36, 47 respectively) recite that the predetermined event is one of an appointment state change, a factory state change, and an alarm event. Ex. 1001, 39:64–67, 41:12–15, 42:05–09, 43:60–64, 45:1–5; 1344 Pet. 61–63.

Claims 7, 15, 22, 37 and 48 (depending from claims 3, 12, 19, 34, 45) recite specific examples of appointments state changes, factory state changes, and alarm events. Ex. 1001, 40:24–40, 41:16–33, 42:10–27, 43:65–44:16, 45:6–25; 1344 Pet. 63–64.

The arguments and supporting evidence are substantively identical to those presented for claim 5 of the '248 patent. *See supra* Section V.E.6 and Sections V.E.3–5. We adopt here the analysis and conclusion stated above with respect to that claim and the sections relied on therein. We determine that Petitioner has demonstrated by a preponderance of the evidence that claims 3, 7, 14, 15, 21, 22, 36, 37, 47 and 48 of the '305 patent would have been unpatentable as obvious over Schulze and Gupta.

3. Claims 9, 17, 24, 39, and 50

Claims 9, 17, 24, 39, and 50 recite additional limitations relating to reactively scheduling an action. Ex. 1001, 40:48–57, 41:43–53, 42:37–46, 44:25–34, 46:6–15; 1344 Pet. 64–65. The arguments and supporting

evidence are substantively identical to those presented for claims 7 and 19 of the '248 patent. *See supra* Section V.E.7. We adopt here the analysis and conclusion stated above with respect to those claims. We determine that Petitioner has demonstrated by a preponderance of the evidence that claims 9, 17, 24, 39, and 50 of the '305 patent would have been unpatentable as obvious over Schulze and Gupta.

4. Claims 10, 11, 18, 25, 40, 51

Claims 10, 11, 18, 25, 40, 51 further recite “proactively scheduling an appointment.” Ex. 1001, 40:58–63 41:53–57, 42:47–50, 44:35–37, 46:16–18. 1344 Pet. 65–66. The arguments and supporting evidence are substantively identical to those presented for claims 8, 9, and 20 of the '248 patent. *See supra* Section V.E.8. We adopt here the analysis and conclusion stated above with respect to those claims. We determine that Petitioner has demonstrated by a preponderance of the evidence that claims 10, 11, 18, 25, 40, and 51 of the '305 patent would have been unpatentable as obvious over Schulze and Gupta.

5. Claims 41 and 52

Claims 41 and 52 recite a limitation of “automated manufacturing system” and “further comprising at least one manufacturing execution system and an automated materials handling system.” Ex. 1001, 44:38–41, 46:19–22; 1344 Pet. 66. Petitioner argues that the Schulze-Gupta combination discloses the further recited limitation of these claims because Schulze’s system includes a manufacturing execution system or MES and further a plurality of semiconductor manufacturing tools. 1344 Pet. 66 (citing Schulze ¶ 40; 1344 Shanfield Decl. ¶ 197). We agree and credit Dr. Shanfield’s testimony in this regard. 1344 Shanfield Decl. ¶ 197.

We determine that Petitioner has demonstrated by a preponderance of the evidence that claims 41 and 52 of the '305 patent would have been unpatentable as obvious over Schulze and Gupta.

6. Claims 42 and 53

Claims 42 and 53 recite further limitations regarding the computing system being “at least one of a local area network, a wide area network, a system area network, an intranet, or a portion of the Internet.” Ex. 1001, 44:42–45, 46:19–26; 1344 Pet. 67. Petitioner argues that Schulze discloses the automated monitoring and assessment system, where a web server “connected to a distributed electronic network . . . such as the Internet, or a proprietary intranet” may be “connected to or incorporated in the automated monitoring and assessment system 407.” 1344 Pet. 67 (citing Schulze ¶¶ 40, 41, 50). We are persuaded by Petitioner’s argument and evidence that Schulze teaches the further recited limitation of claims 42 and 53 of the '305 patent. Accordingly, we determine that Petitioner has demonstrated by a preponderance of the evidence that these claims would have been unpatentable as obvious over Schulze and Gupta.

7. Claim 43

Claim 43 recites the “automated manufacturing environment of claim 33, wherein the process flow comprises a portion of a semiconductor manufacturing facility.” Ex. 1001, 44:46–48; 1344 Pet. 67. Petitioner argues and we agree that Gupta teaches this limitation as it describes that its process flow is performed by interrelated machines in a highly automated “front-end manufacturing facility for integrated circuits.” 1344 Pet. 67; Gupta, code (57), 3:49–51, 57–58; 1344 Shanfield Decl. ¶ 201. Accordingly, we determine that Petitioner has demonstrated by a

preponderance of the evidence that claim 43 of the '305 patent would have been unpatentable as obvious over Schulze and Gupta

VI. PETITIONER'S MOTION TO STRIKE

Petitioner filed a Motion to Strike Improper New Sur-reply Arguments and Evidence as exceeding the scope permitted under 37 C.F.R. § 42.23(b).²³ Rule 23(b) states that “[a]ll arguments for the relief requested in a motion must be made in the motion. A reply may only respond to arguments raised in the corresponding opposition or patent owner response.” Our CTPG states that, “[i]f a party believes that a brief filed by the opposing party raises new issues, is accompanied by belatedly presented evidence, or otherwise exceeds the proper scope of reply or sur-reply, it may request authorization to file a motion to strike.” CTPG at 80. Alternatively, the party may request authorization to file a sur-reply. *Id.* Petitioner here chose the former, which we authorized via email on September 16, 2022.

Although sometimes it may be appropriate for the Board to disregard late-submitted arguments or evidence, we are capable of identifying new issues or belatedly presented evidence when weighing the evidence at the close of trial. *Id.* As such, striking portions of a party's brief is a remedy that we grant rarely. *Id.* However, there may be circumstances in which the prejudice to a party may be too great, such as when a reply clearly relies on a new theory and where addressing the theory during oral hearing would prejudice the opposing party. *Id.* The parties requested a pre-trial

²³ As stated in our discussion of the Background, Petitioner's Motion, Patent Owner's Opposition, and Petitioner's Reply to the Opposition are identical in both proceedings. Thus, for efficiency, citations are made only to the filings in the 1342 IPR.

conference seeking the Board’s guidance regarding the issues raised in the Motion to Strike and we held the pre-trial conference on November 10, 2022. We determined that deciding the Motion to Strike before the oral argument was not in the interests of justice and deferred it for determination at this stage of the proceeding.

We grant *in part* Petitioner’s Motion to Strike as stated below.

A. Enablement

In an obviousness analysis, a reference is considered prior art whether or not it is enabled. See *Amgen Inc. v. Hoechst Marion Roussel, Inc.* (Fed. Cir. 2003) (“Under § 103 . . . a reference need not be enabled; it qualifies as a prior art, regardless, for whatever is disclosed therein”). Prior art is presumed enabled, however, and a party challenging enablement of the prior art may overcome that presumption with evidence that the practice of the invention would have required undue experimentation. See *In re Antor Media Corp.*, 689 F.3d 1282, 1289–90 (Fed. Cir. 2012) (holding that prophetic examples in the prior art are still presumed to be enabling). Patent Owner had that burden here. See *id.* Or at the very least, Patent Owner, as the proponent of the contention that Schulze and/or Gupta are not enabled, should have raised some factually-supported reason for why the reference is not enabled. “[U]nsworn attorney argument . . . is not evidence and cannot rebut . . . evidence.” *Gemtron Corp. v. Saint-Gobain Corp.*, 572 F.3d 1371, 1380 (Fed. Cir. 2009).

Patent Owner’s Sur-reply raised for the first time the argument that Schulze and Gupta were not enabled, without any further elaboration or evidentiary support, stating that “neither disclosure is sufficiently detailed to be enabling of this claim element.” 1342 Sur-reply 6 (citing *Raytheon Techs. Corp. v. GE*, 993 F.3d 1374, 1380 (Fed. Cir. 2021)). By “neither

disclosure” we note the previous paragraph in which Patent Owner asserts that “[n]either the ‘complex and involved process . . . typically performed in manufacture of a semiconductor wafer’ of Schulze, nor the ‘interrelated machines’ of Gupta teach or disclose an integrated process flow *that includes an AMHS* as claimed by the ’248 patent.” *Id.* at 5–6 (emphasis in original). Not only is the assertion unpersuasive because the “integrated, automated process flow” term does not require an AMHS (*see supra* Section IV.C.), the argument lacks any explanation for why *neither* reference would be enabled.

Petitioner argues that Patent Owner did not raise the enablement issue in the Patent Owner Response and that nothing presented in the Reply would have prompted such a rebuttal because of the presumption that prior art is enabling. Mot. 3–4. Patent Owner counters that there is no presumption that prior art is presumed to be enabling and that prior art that on its face is not enabled is not entitled to the presumption. Opp. 4. According to Patent Owner, it would be unfair to strike Patent Owner’s arguments even if the Board finds that the presumption applies. *Id.* We are not persuaded by Patent Owner’s arguments.

The failure of Patent Owner to raise this argument fairly to give Petitioner an opportunity to respond raises concerns as to whether we should consider it. The issue of enablement is a mixed issue of law and fact, where underlying facts may be necessary to support such a conclusion. *Minn. Mining & Mfg. Co. v. Chemque, Inc.*, 303 F.3d 1294, 1301 (Fed. Cir. 2002). The lack of evidence for the proposition that the art is not enabled and the further lack of an opportunity for rebuttal argument make this issue one that is not fully developed on the full record before us, and particularly because it was raised too late. Thus, we agree with Petitioner that this is an issue on

which the late action by Patent Owner unprompted by any argument made by Petitioner in its Reply is sufficient to strike the argument and for the Board not to consider it—notwithstanding that Patent Owner’s arguments lack sufficient explanation and support in order for us to address it properly.

Furthermore, Patent Owner raises in its Opposition the argument that the reference is not enabled *on its face* and that we should consider that argument even if raised late. Opp. 4. We do not agree. Patent Owner does not explain why either or both references (Gupta and Schulze) are not enabled (as opposed to an argument that they do not disclose a specific teaching that Patent Owner deems a claim requirement) on their face. Moreover, they are U.S. patents describing in detail semiconductor manufacturing methods and systems. The comparison of these references to those of other cases in which there was a colorable argument regarding enablement leaves us no choice but to reject Patent Owner’s invitation to take up the issue. *See In re Morsa*, 713 F.3d 104, 110 (Fed. Cir. 2013) (describing that the reference was a short press release and that the patentee did more than just lodge the challenge without explanation). There is no parallel here between the Gupta/Schulze reference and other references found not enabled on their face, and no explanation is given by Patent Owner as to what in either Schulze or Gupta (or both) would necessitate undue experimentation.

Accordingly, we do not consider further and strike the argument that the prior art is not enabled, on its face or otherwise.

B. Claim Construction Arguments

Petitioner moves to strike two claim construction issues raised by Patent Owner in Sur-reply as allegedly outside the scope of a proper reply. First, Petitioner alleges that Patent Owner improperly argues that the claim

language “at least schedules activities” means a software scheduling agent that is not limited to scheduling for “a single manufacturing domain entity.”

Mot. 4–6. Second, Petitioner alleges that Patent Owner raises a new prosecution disclaimer argument that the prosecution history prohibits the “possibility that a given scheduling agent might represent different domain entities at different times.” *Id.* at 6–9. Patent Owner argues that Petitioner is the only party that has raised claim construction issues in this proceeding. Opp. 5. Additionally, Patent Owner asserts that Petitioner submitted the claim construction orders from the district court late and that they became relevant only when Petitioner introduced them. *Id.* Patent Owner admits that it points out the district court claim construction of the term “software scheduling agents” to support that the claim is not limited to scheduling for a single manufacturing domain entity because that claim construction uses the words “at least scheduling.” *Id.* at 7. Patent Owner also argues that the argument regarding the prosecution history is responsive to a “citation” in the Reply. *Id.* Nevertheless, Petitioner points out that these are claim construction positions Patent Owner should have introduced in the Patent Owner Response because they are inconsistent with the district court’s claim constructions and Patent Owner failed to do so. Reply to Opp. 3–4.

In the interest of justice, and given the breadth of arguments regarding claim scope according to the parties’ stated positions, we have considered Patent Owner’s arguments regarding claim construction presented in the Sur-reply, notwithstanding that they indeed are belatedly presented. Accordingly, we do not strike those arguments as requested by Petitioner.

C. Gupta's Technical Obstacle

Petitioner argues that Patent Owner presents improper argument in the Sur-reply when addressing whether the '248 patent's disclosure of "additional software components created by agents to keep track of events within the process flow" render Gupta's six-minute time step a technical obstacle in combining Schulze with Gupta. Mot. 2, 9–10. Patent Owner responds that it properly cites to the '248 patent in response to conclusory and non-specific arguments made by Petitioner's expert that would emphasize the "unbridgeable gaps between the limited scheduling proposed by Gupta and the fab-wide system of the '248 patent." Opp. 8–9. According to Patent Owner, the argument is tied to the incompatibility argument presented in the Response. *Id.* at 9. Patent Owner alleges that Petitioner can claim no prejudice with respect to citations of which it was aware because it submitted the '248 patent in the proceeding. *Id.*

We do not strike Patent Owner's arguments as requested by Petitioner. Although they do run afoul of our rules, in the interests of justice and to consider the full record on issues of claim construction, we considered the arguments made regarding the scope of the '248 patent as informing whether Gupta's six-minute interval would be incompatible. We found the arguments not persuasive. *See supra* V.C.3.

D. Conclusion

We grant Petitioner's Motion to Strike only insofar the enablement argument presented at page 6 of Patent Owner's Sur-reply (in both proceedings) has any merit, which we find does not given the dearth of explanation, factual support, and the depth of the disclosures of Gupta and Schulze. The other arguments that Patent Owner raises, and Petitioner seeks

to strike, though troubling as to their belated presentation and the thin tether to Petitioner's Reply, have been considered in connection with evaluation of the scope of the claims. For these reasons, Petitioner's requests to strike Patent Owner's additional arguments are denied.

VII. CONCLUSION

Having reviewed the argument and supporting evidence of record, and after a full and fair hearing, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 1–22 of the '248 Patent are unpatentable for obviousness over Schulze and Gupta.²⁴

We also determine that Petitioner has demonstrated by a preponderance of the evidence that claims 1–25 and 33–53 of the '305 Patent are unpatentable for obviousness over Schulze and Gupta.²⁵ This Final Written Decision, therefore, addresses all challenged claims of the '248 and the '305 patents. *SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359 (2018) (holding a petitioner “is entitled to a final written decision addressing all of the claims it has challenged”).

The following is a summary of the outcome of this proceeding.

²⁴ 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. 16,654 (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).

²⁵ See *supra* n.24.

For the '248 Patent:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–22	103	Schulze, Gupta	1–22	
<u>Overall Outcome</u>			1–22	

For the '305 Patent:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–25, 33–53	103	Schulze, Gupta	1–25, 33–53	
<u>Overall Outcome</u>			1–25, 33–53	

VIII. ORDER

In consideration of the foregoing, it is hereby

ORDERED that claims 1–22 of the '248 patent are determined to be unpatentable;

FURTHER ORDERED that claims 1–25 and 33–53 of the '305 patent are determined to be unpatentable; and

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

IPR2021-01342 (Patent 6,968,248 B1)

IPR2021-01344 (Patent 6,907,305 B2)

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