

Intertek, located in San Antonio, TX, provides fuel and lubricant testing services for the automotive industry. Within the facility, there are over 65 engine stands and 31 test types that require samples and 5 that require blowbys. Before each shift change, a supervisor will walk around the facility and construct an operator's schedule based on the current engine status and upcoming tests. Operators are responsible for recording critical test readings, taking oil samples and completing blowby measurements within a certain duration at a specified time.



Figure 1- Intertek Engine Stands

Taking the oil sample and conducting a blowby at the appropriate time is critical for quality testing. If the assignment is not completed at the predetermined time interval, the oil is considered scrap. Intertek currently uses a Kanban board and tribal knowledge to assign an operator to an engine stand. With the current scheduling method, operators are often assigned to multiple engines with overlapping tasks; which can lead to missed critical test readings consequently invalidating the test. Figure 2 illustrates the current scheduling methodology. Figure 3 shows the layout of all engine stands and an example of assignment overlap within a 15-minute interval.

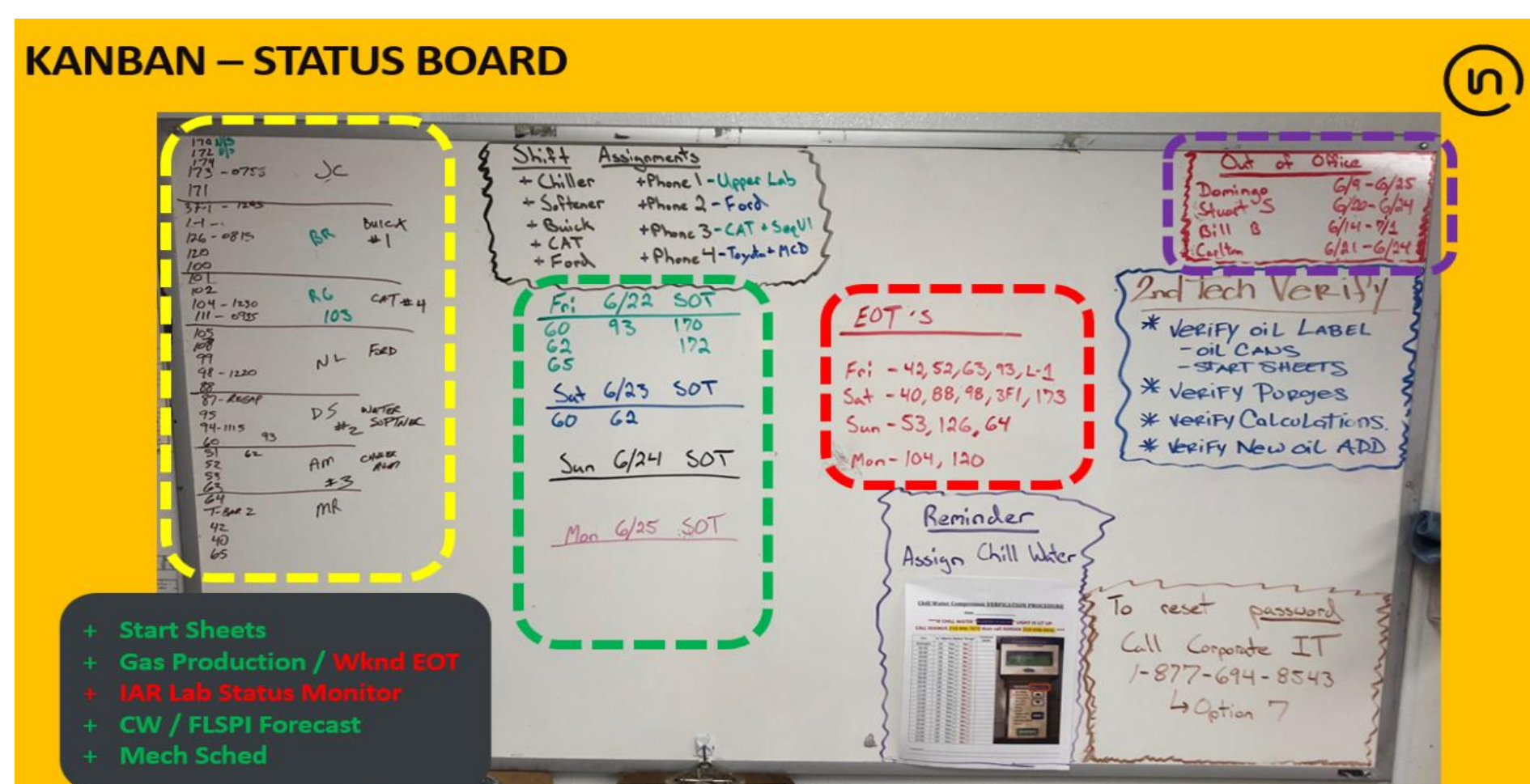


Figure 2 - Intertek Current Scheduling System



Figure 3 - Intertek Facility Layout

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**Main Objective:** Create an application to clearly identify overlapping work assignments

- Import data for all engine stands from Lab Status
- Compile scheduled tasks for each engine stand
- Incorporate ongoing and upcoming tests
- Display engine stand, test type and assignment timetable
- Simple to manage and update

The scheduling application identifies the time to complete each sample and blowby along with any overlapping assignments within a ten-hour shift duration. The application imports the current status of each engine from Intertek's database, Lab Status. With the current status, the time until the next assignment is determined and identified. After the application identifies the time until next assignment for each engine stand into a directed cell, the number of overlapping assignments that occur within a fifteen-minute time interval is known. For clarity, the program highlights upcoming assignments according to the assignment type as well as highlight any tests that are currently running. By clearly identifying these overlapping occurrences, operators can mitigate the risk of missing a scheduled event. The scheduling application (Figure 4) utilizes a color-coded system to assist the user in visually recognizing upcoming sample times, blowby times, running engines, and overlapping assignments.

Schedule Generator		Running Test (No Assignment)		Running Test (Assignment)		Sample		Blowby		Shift Schedule: 11/15/2018 3:53:21 PM																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
Overlapping Assignments		1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		19		20		21		22		23		24		25		26		27		28		29		30		31		32																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
Engine Stand Number	Test Type	0	0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	2.75	3	3.25	3.5	3.75	4	4.25	4.5	4.75	5	5.25	5.5	5.75	6	6.25	6.5	6.75	7	7.25	7.5	7.75	8	8.25	8.5	8.75	9	9.25	9.5	9.75	10	10.25	10.5	10.75	11	11.25	11.5	11.75	12	12.25	12.5	12.75	13	13.25	13.5	13.75	14	14.25	14.5	14.75	15	15.25	15.5	15.75	16	16.25	16.5	16.75	17	17.25	17.5	17.75	18	18.25	18.5	18.75	19	19.25	19.5	19.75	20	20.25	20.5	20.75	21	21.25	21.5	21.75	22	22.25	22.5	22.75	23	23.25	23.5	23.75	24	24.25	24.5	24.75	25	25.25	25.5	25.75	26	26.25	26.5	26.75	27	27.25	27.5	27.75	28	28.25	28.5	28.75	29	29.25	29.5	29.75	30	30.25	30.5	30.75	31	31.25	31.5	31.75	32	32.25	32.5	32.75	33	33.25	33.5	33.75	34	34.25	34.5	34.75	35	35.25	35.5	35.75	36	36.25	36.5	36.75	37	37.25	37.5	37.75	38	38.25	38.5	38.75	39	39.25	39.5	39.75	40	40.25	40.5	40.75	41	41.25	41.5	41.75	42	42.25	42.5	42.75	43	43.25	43.5	43.75	44	44.25	44.5	44.75	45	45.25	45.5	45.75	46	46.25	46.5	46.75	47	47.25	47.5	47.75	48	48.25	48.5	48.75	49	49.25	49.5	49.75	50	50.25	50.5	50.75	51	51.25	51.5	51.75	52	52.25	52.5	52.75	53	53.25	53.5	53.75	54	54.25	54.5	54.75	55	55.25	55.5	55.75	56	56.25	56.5	56.75	57	57.25	57.5	57.75	58	58.25	58.5	58.75	59	59.25	59.5	59.75	60	60.25	60.5	60.75	61	61.25	61.5	61.75	62	62.25	62.5	62.75	63	63.25	63.5	63.75	64	64.25	64.5	64.75	65	65.25	65.5	65.75	66	66.25	66.5	66.75	67	67.25	67.5	67.75	68	68.25	68.5	68.75	69	69.25	69.5	69.75	70	70.25	70.5	70.75	71	71.25	71.5	71.75	72	72.25	72.5	72.75	73	73.25	73.5	73.75	74	74.25	74.5	74.75	75	75.25	75.5	75.75	76	76.25	76.5	76.75	77	77.25	77.5	77.75	78	78.25	78.5	78.75	79	79.25	79.5	79.75	80	80.25	80.5	80.75	81	81.25	81.5	81.75	82	82.25	82.5	82.75	83	83.25	83.5	83.75	84	84.25	84.5	84.75	85	85.25	85.5	85.75	86	86.25	86.5	86.75	87	87.25	87.5	87.75	88	88.25	88.5	88.75	89	89.25	89.5	89.75	90	90.25	90.5	90.75	91	91.25	91.5	91.75	92	92.25	92.5	92.75	93	93.25	93.5	93.75	94	94.25	94.5	94.75	95	95.25	95.5	95.75	96	96.25	96.5	96.75	97	97.25	97.5	97.75	98	98.25	98.5	98.75	99	99.25	99.5	99.75	100	100.25	100.5	100.75	101	101.25	101.5	101.75	102	102.25	102.5	102.75	103	103.25	103.5	103.75	104	104.25	104.5	104.75	105	105.25	105.5	105.75	106	106.25	106.5	106.75	107	107.25	107.5	107.75	108	108.25	108.5	108.75	109	109.25	109.5	109.75	110	110.25	110.5	110.75	111	111.25	111.5	111.75	112	112.25	112.5	112.75	113	113.25	113.5	113.75	114	114.25	114.5	114.75	115	115.25	115.5	115.75	116	116.25	116.5	116.75	117	117.25	117.5	117.75	118	118.25	118.5	118.75	119	119.25	119.5	119.75	120	120.25	120.5	120.75	121	121.25	121.5	121.75	122	122.25	122.5	122.75	123	123.25	123.5	123.75	124	124.25	124.5	124.75	125	125.25	125.5	125.75	126	126.25	126.5	126.75	127	127.25	127.5	127.75	128	128.25	128.5	128.75	129	129.25	129.5	129.75	130	130.25	130.5	130.75	131	131.25	131.5	131.75	132	132.25	132.5	132.75	133	133.25	133.5	133.75	134	134.25	134.5	134.75	135	135.25	135.5	135.75	136	136.25	136.5	136.75	137	137.25	137.5	137.75	138	138.25	138.5	138.75	139	139.25	139.5	139.75	140	140.25	140.5	140.75	141	141.25	141.5	141.75	142	142.25	142.5	142.75	143	143.25	143.5	143.75	144	144.25	144.5	144.75	145	145.25	145.5	145.75	146	146.25	146.5	146.75	147	147.25	147.5	147.75	148	148.25	148.5	148.75	149	149.25	149.5	149.75	150	150.25	150.5	150.75	151	151.25	151.5	151.75	152	152.25	152.5	152.75	153	153.25	153.5	153.75	154	154.25	154.5	154.75	155	155.25	155.5	155.75	156	156.25	156.5	156.75	157	157.25	157.5	157.75	158	158.25	158.5	158.75	159	159.25	159.5	159.75	160	160.25	160.5	160.75	161	161.25	161.5	161.75	162	162.25	162.5	162.75	163	163.25	163.5	163.75	164	164.25	164.5	164.75	165	165.25	165.5	165.75	166	166.25	166.5	166.75	167	167.25	167.5	167.75	168	168.25	168.5	168.75	169	169.25	169.5	169.75	170	170.25	170.5	170.75	171	171.25	171.5	171.75	172	172.25	172.5	172.75	173	173.25	173.5	173.75	174	174.25	174.5	174.75	175	175.25	175.5	175.75	176	176.25	176.5	176.75	177	177.25	177.5	177.75	178	178.25	178.5	178.75	179	179.25	179.5	179.75	180	180.25	180.5	180.75	181	181.25	181.5	181.75	182	182.25	182.5	182.75	183	183.25	183.5	183.75	184	184.25	184.5	184.75	185	185.25	185.5	185.75	186	186.25	186.5	186.75	187	187.25	187.5	187.75	188	188.25	188.5	188.75	189	189.25	189.5	189.75	190	190.25	190.5	190.75	191	191.25	191.5	191.75	192	192.25	192.5	192.75	193	193.25	193.5	193.75	194	194.25	194.5	194.75	195	195.25	195.5	195.75	196	196.25	196.5	196.75	197	197.25	197.5	197.75	198	198.25	198.5	198.75	199	199.25	199.5	199.75	200	200.25	200.5	200.75	201	201.25	201.5	201.75	202	202.25	202.5	202.75	203	203.25	203.5	203.75	204	204.25	204.5	204.75	205	205.25	205.5	205.75	206	206.25	206.5	206.75	207	207.25	207.5	207.75	208	208.25	208.5	208.75	209	209.25	209.5	209.75	210	210.25	210.5	210.75	211	211.25	211.5	211.75	212	212.25	212.5	212.75	213	213.25	213.5	213.75	214	214.25	214.5	214.75	215	215.25	215.5	215.75	216	216.25	216.5	216.75	217	217.25	217.5	217.75	218	218.25	218.5	218.75	219	219.25	219.5	219.75	220	220.25	220.5	220.75	221	221.25	221.5	221.75	222	222.25	222.5	222.75	223	223.25	223.5	223.75	224	224.25	224.5	224.75	225	225.25	225.5	225.75	226	226.25	226.5	226.75	227	227.25	227.5	227.75	228	228.25	228.5	228.75	229	229.25	229.5	229.75	230	230.25	230.5	230.75	231	231.25	231.5	231.75	232	232.25	232.5	232.75	233	233.25	233.5	233.75	234	234.25	234.5	234.75	235	235.25	235.5	235.75	236	236.25	236.5	236.75	237	237.25	237.5	237.75	238	238.25	238.5	238.75	239	239.25	239.5	239.75	240	240.25	240.5	240.75	241	241.25	241.5	241.75	242	242.25	242.5	242.75	243	243.25	243.5	243.75	244	244.25	244.5	244.75	245	245.25	245.5	245.75	246	246.25	246.5	246.75	247	247.25	247.5	247.75	248	248.25	248.5	248.75	249	249.25	249.5	249.75	250	250.25	250.5	250.75	251	251.25	251.5	251.75	252	252.25	252.5	252.75	253	253.25	253.5	253.75	254	254.25	254.5	254.75	255	255.25	255.5	255.75	256	256.25	256.5	256.75	257	257.25	257.5	257.75	258	258.25	258.5	258.75	259	259.25	259.5	259.75	260	260.25	260.5	260.75	261	261.25	261.5	261.75	262	262.25	262.5	262.75	263	263.25	263.5	263.75	264	264.25	264.5	264.75	265	265.25	265.5	265.75	266	266.25	266.5	266.75	267	267.25	267.5	267.75	268	268.25	268.5	268.75	269	269.25	269.5	269.75	270	270.25	270.5	270.75	271	271.25	271.5	271.75	272	272.25	272.5	272.75	273	273.25	273.5	273.75	274	274.25	274.5	274.75	275	275.25	275.5	275.75	276	276.25	276.5	276.75	277	277.25	277.5	277.75	278	278.25	278.5	278.75	279	279.25	279.5	279.75	280	280.25	280.5	280.75	281	281.25	281.5	281.75	282	282.25	282.5	282.75	283	283.25	283.5	283.75	284	284.25	284.5	284.75	285	285.25	285.5	285.75	286	286.25	286.5	286.75	287	287.25	287.5	287.75	288	288.25	288.5	288.75	289	289.25	289.5	289.75	290	290.25	290.5	290.75	291	291.25	291.5	291.75	292	292.25	292.5	292.75	293	293.25	293.5	293.75	294	294.25	294.5	294.75	295	295.25	295.5	295.75	296	296.25	296.5	296.75	297	297.25	297.5	297.75	298	298.25	298.5	298.75	299	299.25	299.5	299.75	300	300.25	300.5	300.75	301	301.25	301.5	301.75	302	302.25	302.5	302.75	303	303.25	303.5	303.75	304	304.25	304.5	304.75	305	305.25	305.5	305.75	306	306.25	306.5	306.75	307	307.25	307.5	307.75	308	308.25	308.5	308.75	309	309.25	

Figure 4- Intertek Scheduling Application Output

**Process Failure Modes and Effects Analysis**  
**Project:** TX-ST Intertek Scheduler - Engine Lab  
**Problem:** Risk Mitigation on Critical Engine Lab Operation Tasks  
**Prepared By:** TX-ST Senior Design Team  
**Date:** 11/27/2018

Process Step	Potential Failure Mode	Potential Failure Effects	S E V	Potential Causes	O C C	Current Controls	D E T	R P N
Time dependent critical tasks for Engine Operators such as Oil Samples, Blowby Measurements, Flushes, etc.	Task not completed within the specified time window	Invalidated customer test due to running outside test procedure. Intertek absorbs all associated test costs on customer behalf	5	Overlapping time dependent tasks	4	Engine Count Form - manually completed prior to each shift to estimate time of critical tasks then equally assign engines to operators	3	6
				Employee Oversight / Prioritization	2	Prioritization of daily tasks is part of onboarding training program	2	2
				Insufficient employee coverage	1	Shift schedules are balanced to maintain coverage across all	1	5

Figure 5 - Intertek PFMEA

The scheduling application was developed through Excel VBA. The application will read from a text file exported from Lab Status and reference the predefined time to complete an assignment. The txt file is set to update every 5 minutes. The schedule is formatted according to the time at which it is generated. With the data from Lab Status and the predefined time to complete an assignment, the time until the next assignment is determined and scheduled. With the Lab Status input as a reference, the scheduling application can accurately identify when to complete an assignment for each test. Once the assignment times are determined, the number of overlapping assignments within a 15-minute time interval are identified and highlighted. The scheduling application will eliminate missed assignments by clearly identifying overlapping assignments and the precise time to complete them. This resource will ultimately reduce human error and optimize operator assignments.

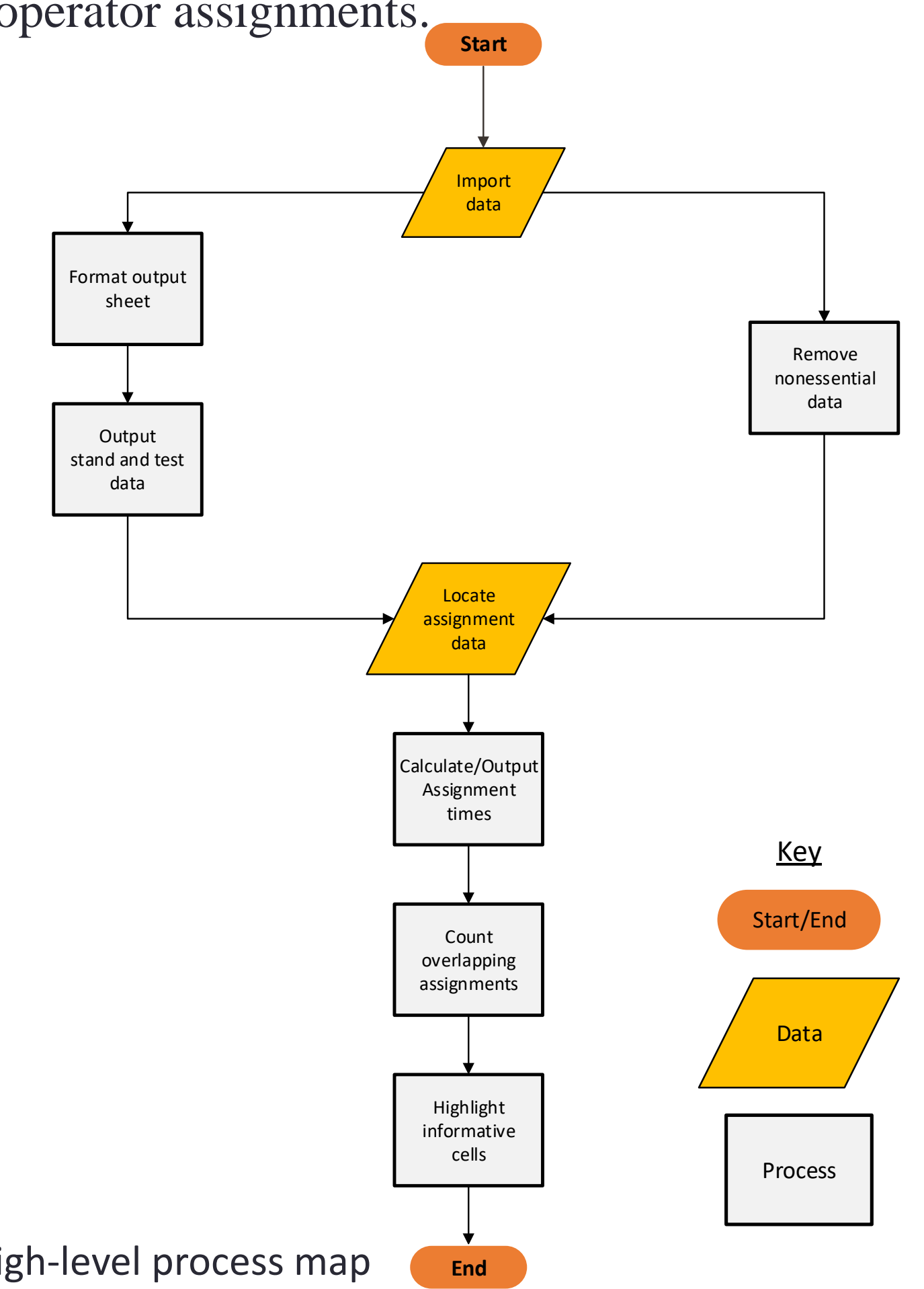


Figure 6 - High-level process map

The scheduling application is a visual aid that identifies upcoming events. This scheduling application will reduce the time and motion spent generating each shift schedule; thus, minimizing the risk of miscommunication between each shift change. Missed assignments and defects will be eliminated by clearly identifying a precise time of occurrence. Through this easy to use application, user error will be minimized.

The application will properly generate the schedule based on only two assignment types. The program will have to be modified if there is an additional assignment type to consider. Having the txt file continuously update will reduce the risk of not properly scheduling properly. Currently, the program works by retrieving the file from a specified location. The location will need to be updated to Intertek's local network.