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PENELITIAN DASAR UNGGULAN PERGURUAN TINGGI
(PDUPT)

PENGEMBANGAN SISTEM DETEKSI DINI PENYEBARAN PENYAKIT MENULAR DENGAN PEMANFAATAN DATA NONKLINIK ONLINE DAN TEKNOLOGI BERBASIS KOMUNITAS

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RINGKASAN

Sistem peringatan dini *disease surveillance* diperlukan untuk menangani penyebaran penyakit menular di Indonesia. Kendala utama pada sistem deteksi dini penyebaran penyakit menular ini adalah pengumpulan dan pengolahan data yang relatif lama sehingga respon penanganan penyakit lambat. Penelitian ini bertujuan mengembangkan sistem deteksi dini penyakit menular yang responsif dengan metode *syndromic surveillance* dan pemanfaatan data nonklinik *online*. Data nonklinik *online* merupakan salah satu alternatif sumber data yang dapat diperoleh secara cepat, dari berbagai sumber, dengan reliabilitas yang masih *acceptable*. Pendekatan *syndromic surveillance* dan pemanfaatan data nonklinik *online* ini cocok diterapkan di Indonesia karena keterbatasan data kesehatan dan infrastruktur pengolahan data kesehatan *real time*, serta masifnya penggunaan media sosial untuk berbagi informasi, termasuk kesehatan.

Metode penelitian mengaplikasikan pendekatan *design-science research*. Pendekatan ini dirancang dalam dua tahap utama, yaitu: (1) mengembangkan dan (2) mengevaluasi sistem deteksi dini penyebaran penyakit menular. Pengembangan sistem diawali dengan cara mengumpulkan dan mengekstraksi data nonklinik *online* untuk sejumlah kasus penyakit menular yang dipilih. Langkah berikutnya adalah memodelkan pola penyebaran penyakit menular dan prediksi daerah berpotensi endemik. Berdasarkan model dari sejumlah kasus penyakit menular, langkah selanjutnya adalah membangun kerangka kerja generik untuk *disease surveillance* penyakit menular. Tahapan terakhir adalah mengevaluasi sistem deteksi dini yang dihasilkan.

Kontribusi penelitian ini terdiri dari kontribusi pengetahuan dan kontribusi aplikatif. Kontribusi pengetahuan di antaranya adalah hasil penelitian dalam bentuk model pola penyebaran penyakit menular, model prediksi daerah berpotensi endemik, kerangka kerja generik pada sistem deteksi dini penyakit menular, dan pemanfaatan data nonklinik *online* untuk membangun sistem yang responsif. Kontribusi secara aplikatif berupa sistem deteksi dini yang dapat digunakan sebagai panduan untuk penanganan penyakit menular dan aplikasi untuk mengumpulkan dan mengesktraksi data nonklinik *online*. Hasil penelitian ini diharapkan menjadi solusi aplikatif dalam usaha pemberantasan penyakit menular di Indonesia.

Luaran yang telah dicapai dalam penelitian ini terdiri dari publikasi ilmiah, hak cipta, dan luaran lainnya. Publikasi karya ilmiah terdiri dari 1 artikel jurnal internasional bereputasi dengan status *accepted*, 1 artikel jurnal internasional bereputasi dengan status *in review*, 1 artikel jurnal nasional terakreditasi dengan status *in review*, dan 1 artikel yang akan diseminasikan pada seminar internasional bulan September 2018. Luaran berikutnya adalah HKI berupa hak cipta dan luaran teknologi berupa aplikasi ekstraksi data nonklinik online Twitter.

PRAKATA

Puji syukur ke hadirat Allah SWT, atas berkat dan rahmatnya, laporan tahun terakhir penelitian dasar unggulan perguruan tinggi yang berjudul "Pengembangan Sistem Deteksi Dini Penyebaran Penyakit Menular dengan Pemanfaatan Data Nonklinik Online dan Teknologi berbasis Komunitas" ini dapat diselesaikan dengan baik.

Penyakit menular masih menjadi salah satu masalah utama bidang kesehatan di Indonesia. Upaya penanganannya dapat dilakukan dengan lebih tepat sasaran jika semua pihak berpartisipasi dalam tindakan promotif, preventif, dan kuratif. Diharapkan dengan penggunaan teknologi informasi untuk *disease surveillance* di Indonesia, hasil penelitian ini dapat menjadi solusi yang aplikatif dalam pemberantasan penyakit menular di Indonesia.

Pada tahun kedua ini, fokus penelitian adalah mengembangkan aplikasi ekstraksi data dari media sosial Twitter. Hal ini didasarkan pada evaluasi kesulitan pelaksanaan penelitian pada tahun pertama yaitu pada akses data di media sosial. Dari sejumlah media sosial, Twitter menyediakan sejumlah opsi untuk akses data baik secara langsung maupun melalui program pihak ketiga.

Pelaksanaan penelitian ini mengalami sejumlah kendala. Namun demikian, tim peneliti tetap berkomitmen untuk menyelesaikannya sebaik mungkin. Penyusunan laporan ini juga masih belum sempurna. Oleh karena itu, tim peneliti mengharapkan kritik dan saran yang konstruktif untuk perbaikan selanjutnya. Akhir kata, semoga laporan ini dapat bermanfaat bagi para pembaca.

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BAB 1. PENDAHULUAN

1.1. Latar Belakang

Salah satu faktor utama memaksimalkan potensi bonus demografis penduduk Indonesia pada dekade 2020 – 2030 adalah meningkatkan kualitas kesehatan, baik kesehatan personal maupun kesehatan kolektif di masyarakat. Permasalahan rumit di bidang kesehatan yang saat ini dihadapi rakyat Indonesia adalah kompleksitas pola penyakit akibat transisi epidemiologi, yaitu penyakit menular masih menjadi penyebab kematian yang cukup tinggi dan pada saat yang sama, penyakit tidak menular meningkat secara drastis (WHO, 2014; Fahmi, 2008). Berdasarkan data Kementerian Kesehatan tahun 2014 dan data WHO tahun 2014, terdapat penyakit menular (Tuberculosis) dan penyakit tidak menular degeneratif (seperti cerebrovascular, jantung iskemik, dan diabetes melitus) yang menjadi 10 penyebab kematian tertinggi di Indonesia (WHO, 2014; Kemenkes, 2014).

Meskipun kedua jenis penyakit tersebut mengancam kualitas sumber daya manusia Indonesia secara keseluruhan, penyakit menular memiliki karakteristik khusus, yaitu resiko penyebaran penyakit yang cepat dan berdampak luas. Kejadian luar biasa wabah penyakit masih menjadi permasalahan serius di sejumlah daerah dan di musim tertentu. Berdasarkan data Kementerian Kesehatan di tahun 2014, penyakit menular yang diwaspadai karena berpotensi Kejadian Luar Biasa (KLB) atau beresiko tinggi adalah Tuberculosis (TB), Human Immunodeficiency Virus (HIV/AIDS), Diare, dan penyakit tropis (demam berdarah Dengue, Chikungunya, Malaria, dan Filariasis). Bahkan penyakit TB menjadi salah satu dari 10 penyebab utama kematian tertinggi di Indonesia (WHO, 2014; Kemenkes, 2014). Di akhir tahun 2017 ini, muncul KLB penyakit Difteri di 95 kabupaten dan kota di 20 provinsi di Indonesia (Kemenkes, 2017). Hingga bulan November 2017, sudah terjadi 622 kasus difteri dengan 32 kasus diantaranya meninggal dunia.

Penanganan terhadap penyakit menular meliputi tindakan promotif, preventif, dan kuratif yang membutuhkan partisipasi aktif masyarakat, penyedia layanan kesehatan, dan pemerintah. Salah satu upaya pemberantasan penyakit menular adalah melalui sistem peringatan dini *disease surveillance* (pengawasan penyakit) untuk menekan laju penyebaran penyakit menular. Hal tersebut dapat dilakukan dengan cara memetakan daerah endemik secara tepat, menganalisis pola penyebaran penyakit, dan memprediksi potensi daerah endemik berikutnya. Pemetaan daerah endemik

membantu pihak penyedia layanan dan pemerintah melakukan tindakan kuratif dan upaya pemberantasan penyakit yang lebih terfokus dan tepat sasaran. Analisis pola penyebaran penyakit dan prediksi potensi daerah endemik mengisolir daerah endemik dan mencegah perluasan penyebaran penyakit. Selanjutnya, berdasarkan hasil prediksi, pihak layanan kesehatan dan pemerintah dapat menyelenggarakan upaya preventif di daerah potensi endemik, seperti pemberdayaan masyarakat melalui metode *Participatory Hygiene and Sanitation Transformation* (PHAST), pemberian pendidikan kesehatan publik, dan perbaikan atau pembangunan fasilitas kesehatan yang diperlukan.

Salah satu kendala utama pada sistem deteksi dini penyebaran penyakit menular adalah pengumpulan dan pengolahan data. Pengumpulan data diagnosis dan pemrosesannya membutuhkan waktu yang tidak sebentar sehingga respon penanganan penyakit lambat. Respon yang lambat berdampak signifikan terhadap penyebaran penyakit menular. Hal tersebut diperparah dengan kondisi beberapa daerah endemik di Indonesia yang padat penduduk dan rendahnya kualitas sanitasi sehingga laju penyebaran penyakit semakin tinggi. Oleh karena itu, dibutuhkan metode pengumpulan dan pengolahan data primer yang cepat dan cukup akurat, misalnya dengan teknik *syndromic surveillance* atau *infodemiology*. *Syndromic surveillance* menggunakan *near real time data* (data yang mendekati waktu nyata) dan perangkat otomatis untuk mendeteksi aktivitas yang tidak biasa untuk diinvestigasi lebih lanjut (Ohkusa et al., 2005; Seo et al., 2014), jenis pendekatan ini banyak digunakan untuk penyakit langka atau yang belum dikenal. *Infodemiology* adalah penggunaan sumber data nontradisional untuk mendeteksi tren dan wabah penyakit (Eysenbach, 2006). Sumber data tersebut berasal dari layanan berbasis komunitas yang berupa *query* pencarian di mesin pencari, media sosial, artikel web dan blog. Kedua teknik tersebut sesuai untuk diterapkan di Indonesia karena keterbatasan data kesehatan dan infrastruktur pengolahan data kesehatan *real time*, serta masifnya penggunaan media sosial untuk berbagi informasi, termasuk kesehatan.

Penyakit menular masih menjadi salah satu masalah utama bidang kesehatan di Indonesia. Upaya penanganannya dapat dilakukan dengan lebih tepat sasaran jika semua pihak berpartisipasi dalam tindakan promotif, preventif, dan kuratif. Teknologi informasi berbasis komunitas (seperti *community experience sharing*, *community of practice*, dan *e-patient*) dapat dimanfaatkan untuk mengatasi permasalahan penyebaran penyakit menular, yaitu melalui analisis pola penyebaran penyakit

menular dan deteksi daerah potensi endemik penyakit menular. Diharapkan dengan penggunaan teknologi informasi untuk *disease surveillance* di Indonesia, hasil penelitian ini dapat menjadi solusi yang aplikatif dalam pemberantasan penyakit menular di Indonesia.

Penelitian di bidang informatika kesehatan ini sejalan dengan salah satu tema unggulan rencana strategis penelitian di Universitas Airlangga, yaitu "Pemodelan dan Desain Sistem di Bidang Life Science, Ekonomi dan Industri Berbasis ICT". Isu strategis yang dibahas dalam penelitian ini adalah banyaknya penyebaran penyakit yang belum terkendali. Topik penelitian unggulan penelitian di Universitas Airlangga yang dikerjakan pada penelitian ini adalah model matematika untuk mengendalikan penyebaran suatu penyakit. Penurunan tema penelitian unggulan Universitas Airlangga menjadi usulan judul penelitian PDUPT pada proposal ini dapat dilihat pada Gambar 1.1.

1.2. Rumusan Masalah

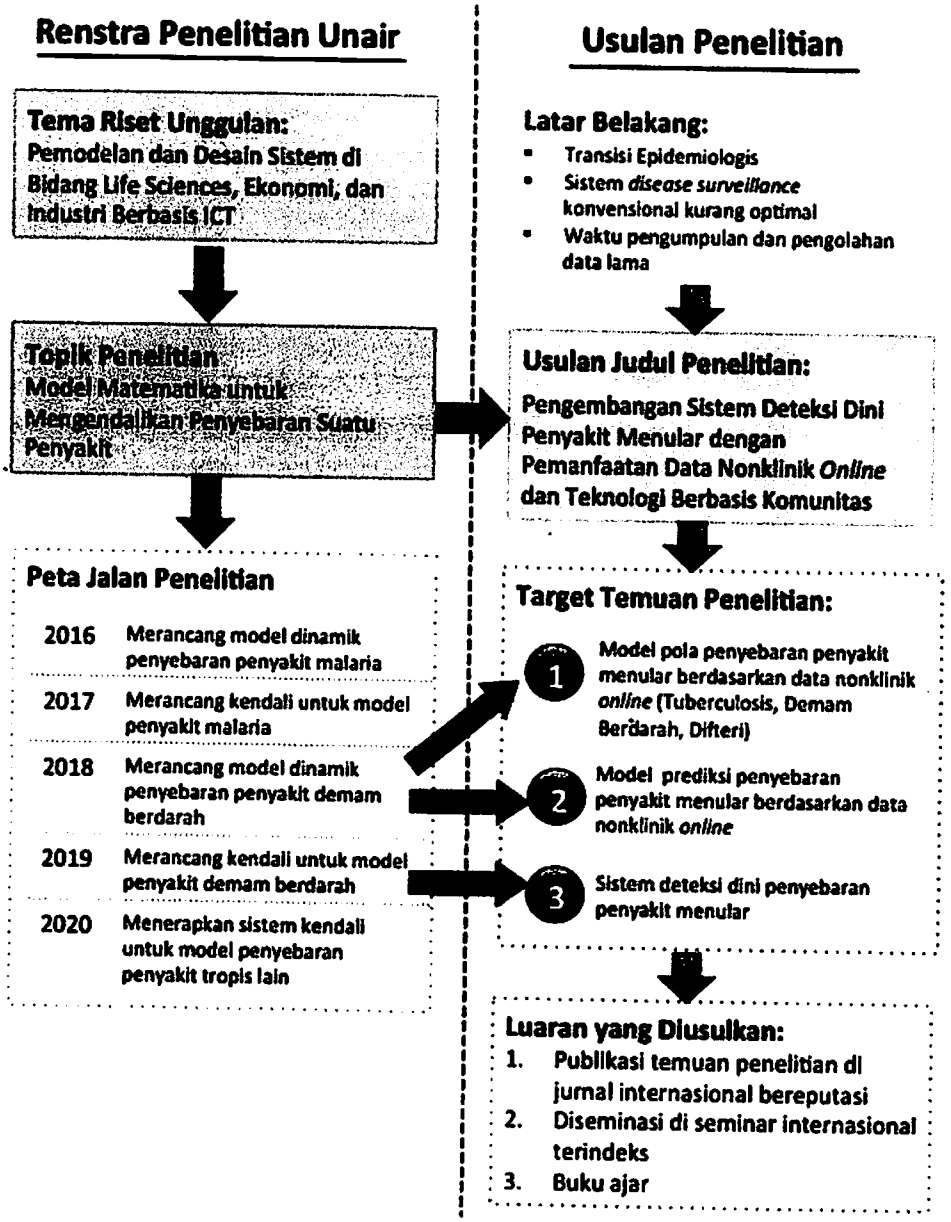
Berdasarkan latar belakang yang telah disampaikan, rumusan masalah pada penelitian ini adalah:

1. Bagaimana menganalisis pola penyebaran penyakit menular dan memprediksi daerah berpotensi endemik dengan pengolahan data nonklinik *online* dan penggunaan teknologi berbasis komunitas?
2. Bagaimana memprediksi daerah berpotensi endemik dengan pengolahan data nonklinik *online* dan penggunaan teknologi berbasis komunitas?
3. Bagaimana mengembangkan sistem deteksi dini penyebaran penyakit menular dengan pemanfaatan data nonklinik *online* dan penggunaan teknologi berbasis komunitas?

1.3. Urgensi Penelitian

Pemberantasan penyakit menular di Indonesia adalah salah satu agenda utama *Millennium Development Goal* (MDG) untuk meningkatkan kualitas masyarakat Indonesia. Pemberantasan penyakit menular bukan hanya tanggung jawab penyedia layanan kesehatan dan pemerintah, tetapi juga membutuhkan peran aktif masyarakat. Salah satu peran aktif masyarakat yang dapat dimanfaatkan untuk membangun solusi pemberantasan penyakit menular adalah melalui media sosial dan penggunaan Internet untuk mencari informasi kesehatan. Pemanfaatan media sosial di Indonesia

dan peningkatan penggunaan Internet untuk mencari informasi kesehatan merupakan potensi yang sangat baik untuk membangun solusi pemberantasan penyakit menular yang lebih cepat dan efektif.



Gambar 1.1 Kesesuaian Usulan Judul Proposal dengan Rencana Strategis Penelitian Universitas Airlangga

1.4. Target Temuan dan Luaran Penelitian

Berdasarkan luaran yang ditargetkan dan waktu pelaksanaan, rencana capaian tahunan penelitian ini dijelaskan di Tabel 1.1.

Tabel 1.1 Rencana Target Capaian Tahunan

No	Jenis Luaran				Indikator Capaian	
	Kategori	Sub Kategori	Wajib	Tambahan	TS	TS+1
1	Artikel ilmiah dimuat di jurnal	Internasional bereputasi	V	V	*accepted*	*accepted/ published*
		Nasional Terakreditasi		V	tidak ada	*published*
2	Artikel ilmiah dimuat di prosiding	Internasional Terindeks		V	Sudah dilaksana-kan	Sudah dilaksana-kan
		Nasional			tidak ada	tidak ada
3	*Invited Speaker* dalam temu ilmiah	Internasional			tidak ada	tidak ada
		Nasional			tidak ada	tidak ada
4	*Visiting Lecturer*	Internasional			tidak ada	tidak ada
5	Hak Kekayaan Intelektual (HKI)	Paten			tidak ada	tidak ada
		Paten Sederhana			tidak ada	tidak ada
		Hak Cipta		V	tidak ada	*granted*
		Merek Dagang			tidak ada	tidak ada
		Rahasia Dagang			tidak ada	tidak ada
		Desain Produk Industri			tidak ada	tidak ada
		Indikasi Geografis			tidak ada	tidak ada
		Perlindungan Varietas Tanaman			tidak ada	tidak ada
		Perlindungan Topografi Sirkuit Terpadu			tidak ada	tidak ada
6	Teknologi Tepat Guna				tidak ada	tidak ada
7	Model/Purwarupa/Desain/Karya seni/ Rekayasa Sosial			V	draf	produk
8	Bahan ajar			V	draf	tidak ada
9	Tingkat Kesiapan Teknologi (TKT)				3	3

1.5. Luaran Penelitian

Penelitian ini berkontribusi pada ilmu pengetahuan dan aplikasi yang bermanfaat bagi para pemangku kepentingan di bidang kesehatan dan masyarakat. Luaran penelitian berupa:

1. Karya ilmiah yang dipublikasikan pada jurnal internasional bereputasi yang berdampak faktor, seperti *Health Information and Libraries Journal, International Journal of Business Information Systems.*

2. Karya ilmiah yang dipresentasikan pada konferensi internasional dan dipublikasikan pada prosiding yang terindeks Scopus.
3. Model kerangka kerja sistem deteksi dini penyebaran penyakit menular yang dapat digunakan sebagai panduan penanganan dan pencegahan penyakit menular.
4. Sistem perangkat lunak, berupa aplikasi pengolah data nonklinik *online* dan aplikasi model penyebaran penyakit menular.

BAB 2. TINJAUAN PUSTAKA

Konsep yang dibutuhkan untuk menjalankan penelitian ini terdiri dari konsep *disease surveillance*, *e-patient* dan *e-participatory medicine*, model matematika untuk penyebaran penyakit, teknologi berbasis komunitas, dan metodologi *design science research* untuk penelitian bidang Sistem dan Teknologi Informasi.

2.1. *Disease Surveillance* dengan Pemanfaatan Data Nonklinik

Kejadian pandemi global, seperti wabah penyakit flu burung (virus H5N1) di Indonesia pada tahun 2003 – 2005 dan wabah penyakit Ebola pada tahun 2013 – 2016 (WHO, 2014), menunjukkan pentingnya sistem peringatan dini yang dapat mendeteksi wabah penyakit dan daerah berpotensi endemik secara cepat. Jika menunggu data diagnosis yang sudah terkonfirmasi, maka fungsi deteksi dini menjadi tidak optimal karena lamanya pengumpulan dan pemrosesan data. Oleh karena itu, jenis data yang paling sesuai adalah data yang dapat diperoleh secara cepat dari berbagai sumber, seperti data sindromik (May et al., 2009), yang terdiri dari data klinik (Yom-Tov et al., 2014) dan data nonklinik (Bernardo et al. 2013; Seo et al., 2014). Data klinik meliputi kunjungan pasien, *Electronic Health Record*, penjualan resep obat, hasil laboratorium / radiologi), sedangkan data sindromik (nonklinik) terdiri dari data obat bebas, catatan absensi pekerja dan pelajar di suatu daerah, data pencarian informasi kesehatan di Internet (Eysenbach, 2006; Ginsberg et al., 2009; Polgreen et al., 2008), dan data media sosial (Seo et al., 2014; Yom-Tov et al. 2014).

Sejumlah penelitian terbaru di bidang informatika kesehatan menggunakan data nonklinik dari teknologi mesin pencari untuk keperluan *disease surveillance*, seperti analisis deteksi epidemi flu dengan memanfaatkan Google Flu (Pervaiz et al., 2012), *influenza surveillance* dengan analisis *query* pencarian di mesin pencari (Eysenbach, 2006; Ginsberg et al., 2009; Polgreen et al., 2008), deteksi wabah penyakit di peristiwa berkumpulnya massa dalam jumlah besar (misalnya, konser musik di lapangan dan festival keagamaan) dengan analisis data internet (Yom-Tov et al., 2009), dan analisis data *query* mesin pencari untuk deteksi pandemi influena (Ginsberg et al., 2009). Data media sosial juga digunakan dalam pengembangan sistem *disease surveillance*, seperti sistem penelurusan laju penyebaran influenza di Inggris (Lampos et al., 2010; Culotta, 2010), analisis *Tweets* sepanjang terjadinya wabah H1N1 tahun 2009 (Chew & Eysenbach, 2010), estimasi laju penyebaran

influenza dan volume penjualan alkohol dengan data dari Twitter dan metode *lighweight* (Culotta, 2012)

2.2. Konsep *Wisdom of Crowd* dan Teknologi berbasis Komunitas

Data yang berkualitas merupakan prasyarat suatu sistem dapat menjalankan fungsinya dengan optimal. Kualitas data dinyatakan dengan sejumlah faktor, yaitu konsistensi, akurasi, validitas, kelengkapan, dan integritas. Pada sistem tertentu, satu atau beberapa faktor kualitas data tidak dapat dipenuhi karena mengejar optimalisasi volume dan/atau waktu pemrosesan data. Untuk menjaga kualitas luaran sistem keseluruhan di level *acceptable* (layak), sistem menggunakan data dari berbagai sumber. Fungsi heuristik untuk validasi pendekatan tersebut adalah dengan menggunakan konsep *wisdom of crowd*. Pada *wisdom of crowd*, agregat solusi dari kelompok dinilai sama atau bahkan lebih baik daripada mayoritas solusi individu (Yi et al., 2009), estimasi median dari kelompok dapat lebih akurat daripada estimasi pakar (Surowiecki, 2005; Vul & Pashler, 2008).

Teknologi berbasis komunitas, seperti media sosial, sistem *community of practice* (komunitas praktisi), sistem kolaborasi enterprise, dan komunitas *online* lainnya menerapkan konsep *wisdom of crowd* dalam pemberian layanan informasi. Contoh aplikasi *wisdom of crowd* adalah Wikipedia (www.wikipedia.org), ensiklopedi online ini dikelola dan disunting bersama oleh komunitas kontributornya. Dari sisi akurasi informasi, meskipun Wikipedia tidak disarankan untuk disitasi dalam publikasi ilmiah, tetapi kualitas isinya dinilai mendekati atau setara dengan ensiklopedia Britannica yang ditulis oleh para pakar (Reavley et al., 2011; Wiegand, 2007). Salah satu penelitian yang menganalisis kualitas artikel Wikipedia bidang farmakologi menyebutkan bahwa akurasi artikel Wikipedia yang diteliti adalah 99,7% dan kelengkapannya adalah 83,8% dibandingkan dengan buku teks (Kräenbring et al., 2014). Pendekatan *wisdom of crowds* atau partisipasi komunitas dapat dimanfaatkan untuk sistem *disease surveillance*, yang membutuhkan pengumpulan data yang akurasinya secara cepat dari berbagai sumber.

2.3. Model Epidemik Penyebaran Penyakit Menular

Penyebaran penyakit menular dapat dimodelkan dengan pendekatan matematis, spasial, dan gabungan keduanya. Model penyebaran penyakit klasik menggunakan pendekatan matematis dengan asumsi: populasi di mana agen patogenik aktif, terdiri

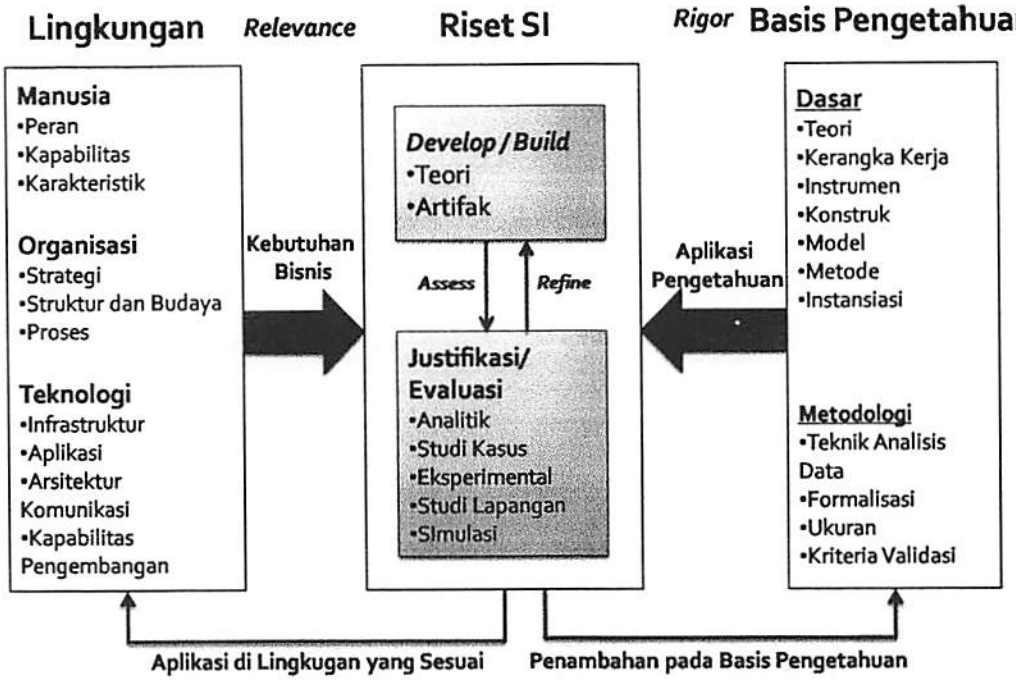
dari sejumlah subkelompok yang berbeda, dan yang dianalisis hanya dinamika temporal dari siklus infeksi penyakit. Contoh model klasik ini diantaranya adalah model deterministik berdasarkan klasifikasi populasi total (SIR: Susceptible Infected Recovered, SEI: Susceptible Exposed Recovered, dan SEIR: Susceptible Exposed Infected Recovered) (Kermack & McKendrick, 1927; Di Stefano et al., 2000), *differential equation model* (Ching Fu & Milne, 2003), dan model tipe *mean-field* (Kleczkowski & Grenfell, 1999).

Penyebaran penyakit menular di suatu populasi manusia terjadi dalam suatu ruang geografis dari satu tempat ke tempat lainnya mengikuti pergerakan penderitanya. Sejumlah penelitian menyertakan pendekatan spasial geografis untuk memodelkan penyebaran penyakit menular dengan lebih akurat. Contohnya adalah model *Cellular Automata* yang mengidentifikasi karakteristik lokasi populasi yang rentan terhadap suatu penyakit menular (Sirakoulis & Karafyllidis, 2000; Perez & Dragicevic, 2009), dan *agent-based modeling* yang memodelkan populasi yang rentan tertular, jalur pergerakan sebaran penyakit, dan kontak antar individu dalam suatu area geografis (Gordon, 2003; Dunham, 2005).

2.4. Design Science Research

Hevner dkk. mengemukakan dua paradigma yang mendasari sebagian besar riset di disiplin Sistem dan Teknologi Informasi, yaitu *behavioural science* dan *design science* (Hevner & Chatterjee, 2010). *Behavioural science* membangun dan menjustifikasi teori (seperti hukum dan prinsip) yang menjelaskan atau memprediksi fenomena manusia dan organisasi di seputar analisis, desain, implementasi, manajemen, dan penggunaan sistem informasi. Paradigma kedua, *yaitu design science* atau paradigma *problem solving*, berakar dari kerekayasaan dan ilmu artifisial. Paradigma *design science* berusaha memperluas kapabilitas manusia dan organisasi dengan membuat artefak baru dan inovatif. Artefak TI yang dihasilkan terdiri dari *construct* (kosa kata dan simbol-simbol), model (abstraksi dan representasi), *methods* (algoritma dan praktik), dan *instantiation* (implementasi dan prototipe sistem).

Kerangka kerja yang menyatakan keterhubungan antara dua paradigma riset Sistem Informasi divisualisasikan pada Gambar 2.1.



Gambar 2.1 Kerangka Kerja Riset Sistem Informasi (modifikasi dari von Alan et al., 2004)

2.5. Penelitian terkait yang sudah dikerjakan sebelumnya

Penelitian ini merupakan pengembangan dari penelitian sebelumnya yang telah dilakukan dalam topik umum Informatika Kesehatan. Penelitian sebelumnya membahas tentang pola pencarian informasi kesehatan secara *online*, termasuk pencarian informasi penyakit menular. Penelitian tersebut sudah didiseminasi pada seminar Internasional (Puspitasari dkk., 2014) dan dipublikasikan pada jurnal internasional (Puspitasari dkk., 2015 Puspitasari, 2017). Hasil dari penelitian tersebut adalah adanya pola spesifik dalam pencarian informasi kesehatan oleh pengguna Internet dan potensi pemanfaatan data perilaku pengguna untuk mendukung kesehatan publik.

Penelitian selanjutnya adalah tentang pengembangan sistem *e-patient* berbasis media sosial untuk berbagi informasi kesehatan dan pengalaman dalam pengobatan penyakit (Puspitasari dkk., 2017). Penelitian tersebut dialatarbelakangi oleh semakin meningkatnya aktivitas berbagi informasi kesehatan dan konsultasi melalui media sosial umum. Hasil penelitian berupa sistem *e-patient*, yatu Pasienesia, yang menghubungkan pengguna atau *consumer* dengan profil kesehatan yang sama. Selain itu, sistem juga memfasilitasi konsultasi *online* dengan dokter, spesialis, dan petugas kesehatan profesional lainnya.

Data tentang pencarian informasi kesehatan secara *online* dapat dimanfaatkan untuk mengidentifikasi potensi kejadian luar biasa penyakit menular di suatu daerah. Salah satu caranya adalah dengan melacak lokasi pengguna Internet melakukan pencarian kesehatan *online*. Data tersebut selanjutnya dapat diolah untuk menentukan estimasi pergerakan penyebaran penyakit menular, seperti yang akan dilakukan pada penelitian ini.

BAB 3. TUJUAN DAN MANFAAT PENELITIAN

Tujuan penelitian terdiri dari:

1. Mengambangkan aplikasi untuk ekstraksi data dari media sosial berdasarkan kata kunci, lokasi geografis, dan periode *data submission*.
2. Mengembangkan model analisis pola penyebaran penyakit menular dan model prediksi daerah berpotensi endemik dengan data nonklinik *online* yang bersumber dari media sosial dan teknologi berbasis komunitas.
3. Mengembangkan model prediksi daerah berpotensi endemik dengan data nonklinik *online* dan teknologi berbasis komunitas.
4. Mengembangkan sistem deteksi dini penyebaran penyakit menular dengan pemanfataan data nonklinik *online* dan penggunaan teknologi berbasis komunitas.

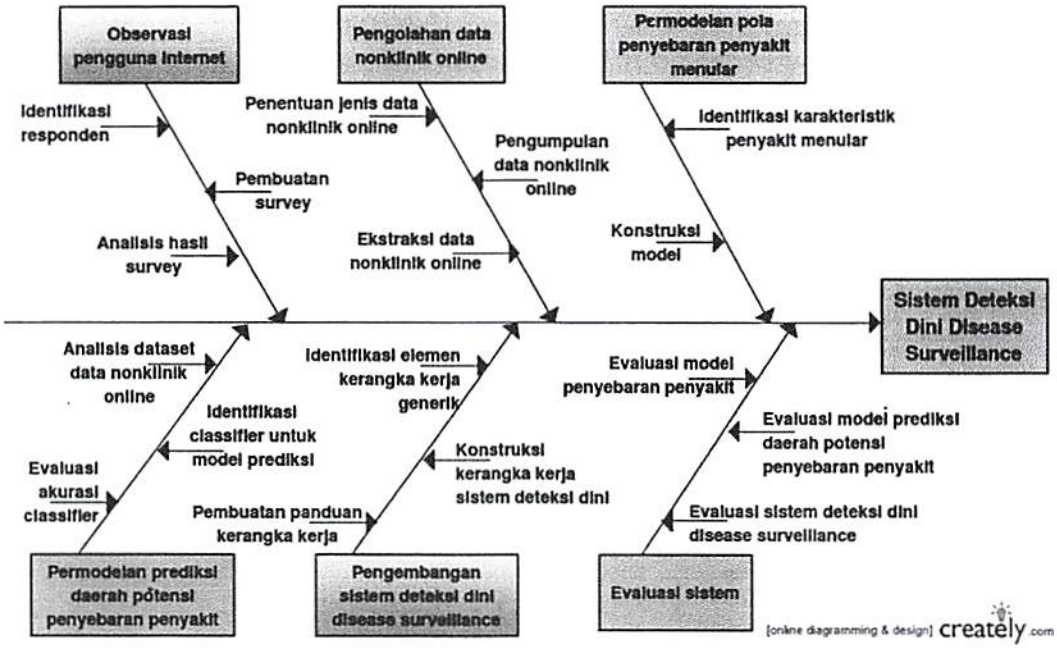
Hasil dari penelitian ini dapat dimanfaatkan oleh praktisi dan peneliti bidang Sistem Informasi dan Kesehatan Masyarakat sebagai berikut:

1. Manfaat penelitian di bidang Sistem Informasi
   a. Pengembangan ilmu di bidang Sistem Informasi Kesehatan, khususnya dalam hal model perilaku penggunaan media sosial dan mesin pencari dalam bidang kesehatan, model *health information sharing*, dan metode pengumpulan data kesehatan *real time*.
   b. Sistem deteksi dini penyakit menular dapat digunakan sebagai panduan untuk membangun model penyebaran penyakit menular dan prediksi daerah berpotensi endemik untuk penyakit menular lainnya yang tidak dibahas dalam penelitian ini.
2. Manfaat penelitian di bidang Analisis Data
   Implementasi *library twint* untuk ekstraksi data di media sosial Twitter berdasarkan kata kunci spesifik dan lokasi geografis. Periode data yang diperoleh adalah data terawal hingga data terbaru berdasarkan urut waktu.

3. Manfaat penelitian di bidang Kesehatan Masyarakat
   a. Model pola penyebaran penyakit yang dapat digunakan oleh penyedia layanan kesehatan dan pemerintah untuk menjalankan tindakan promotif, preventif, dan kuratif penyakit menular
   b. Model prediksi daerah berpotensi endemik dapat digunakan oleh penyedia layanan kesehatan dan pemerintah untuk menghambat sebaran daerah endemik penyakit menular.

BAB 4. METODE PENELITIAN

Penelitian ini merupakan aplikasi dari *design-science*. Penelitian berjenis *design-science* dilakukan dengan membangun dan mengevaluasi artifak berupa sistem deteksi dini penyebaran penyakit menular. Bagan alur penelitian yang akan dilakukan berupa diagram *fishbone* diagram dapat dilihat pada Gambar 3.1.



Gambar 4.1 Diagram *Fishbone* Alur Penelitian

4.1. Tahapan Penelitian

Tahapan penelititan secara lengkap adalah sebagai berikut.

1. Studi Literatur

   Kegunaan studi literatur pada penelitian ini adalah untuk mengidentifikasi permasalahan kritikal di bidang kesehatan, limitasi dari solusi yang telah ada, dan bagaimana pemanfaatan sistem dan teknologi informasi dapat membangun solusi yang lebih efektif. Studi literatur membentuk basis pengetahuan (fondasi dan metodologi) yang relevan terhadap penelitian yang dikerjakan. Fondasi dibangun dengan cara mengeksplorasi konsep *disease surveillance*, konsep *wisdom of crowds* dan teknologi berbasis komunitas, pola penyebaran penyakit, dan permodelan prediksi. Sementara metodologi yang digunakan pada penelitian ini adalah *design science research*.

2. Observasi perilaku pengguna Internet di Indonesia dalam mencari dan mengakses informasi kesehatan secara *online*, baik melalui media sosial, mesin pencari, atau aplikasi komunitas kesehatan.
3. Pengumpulan dan ekstraksi data nonklinik *online*

   Tahapan ini diawali dengan menentukan jenis penyakit menular yang akan diinvestigasi dan menyusun daftar kata kunci yang berisi terminologi yang bersesuaian dengan jenis penyakit yang telah ditentukan dalam bahasa Indonesia dan bahasa Inggris. Selanjutnya, membuat aplikasi untuk mengumpulkan dan mengektraksi secara otomatis data nonklinik *online* yang mengandung minimal satu terminologi yang terdapat di daftar kata kunci. Sumber data nonklinik *online* adalah catatan *posting* tentang penyakit menular di media sosial dan *query* dari mesin pencari. Salah satu hasil ekstraksi data adalah data spasial berupa lokasi aktivitas pencarian dan pengaksesan informasi kesehatan dilakukan.
4. Permodelan pola penyebaran penyakit menular dengan pendekatan matematis dan spasial.
5. Permodelan prediksi daerah berpotensi endemik berdasarkan pola penyebaran dan karakteristik penyakit.

   Tahapan penelitian nomor 3 sampai 5 akan dilakukan lebih dari sekali. Tiap iterasi memodelkan satu jenis penyakit menular dan tiap personil tim peneliti melakukan iterasi sebanyak satu kali dalam satu tahun anggaran. Kriteria pemilihan penyakit menular yang akan dimodelkan adalah dampak penyakit menular dan karakteristik penyakit.
6. Pembangunan sistem deteksi dini penyebaran penyakit menular

   Sistem deteksi dini pada tahapan ini berupa kerangka kerja generik untuk *disease surveillance* penyakit menular. Elemen kerangka kerja terdiri dari model pola penyebaran penyakit menular, model prediksi daerah berpotensi endemik, dan panduan penggunaan kerangka kerja.
7. Evaluasi

   Evaluasi dilakukan terhadap model pola penyebaran penyakit, model prediksi daerah berpotensi endemik, dan sistem deteksi dini penyebaran penyakit menular. Model dievaluasi dengan uji akurasi, sedangkan sistem deteksi dini dievaluasi dengan metode analitik dan deskriptif.

4.2. Hasil Penelitian

Ringkasan tahapan penelitian dan hasil tiap tahapan penelitian dapat dilihat pada Tabel 4.1. Seluruh pelaksanaan tahapan penelitian dilakukan di institusi tim peneliti di Universitas Airlangga.

Tabel 4.1 Ringkasan tahapan penelitian dan hasil

Elemen konsep *design science*	**Tahapan Penelitian**	**Hasil**
Basis Pengetahuan	1. Studi Literatur a. Fondasi: konsep *disease surveillance*, konsep *wisdom of crowds* dan teknologi berbasis komunitas, pola penyebaran penyakit, dan permodelan prediksi. b. Metodologi: *design science research*.	1.1 Identifikasi rumusan masalah
Pembangunan artefak	2. Observasi perilaku pengguna Internet di Indonesia dalam mencari dan mengakses informasi kesehatan secara *online*	2.1 Model perilaku akses dan pencarian informasi kesehatan
	3. Pengumpulan dan ekstraksi data nonklinik *online*	3.1 Daftar kata kunci 3.2 Aplikasi / *script* untuk mengumpulkan dan mengekstraksi data secara otomatis 3.3 Hasil ekstraksi data nonklinik *online*
	4. Permodelan pola penyebaran penyakit menular dengan pendekatan matematis dan spasial	4.1 Model pola penyebaran penyakit menular
	5. Permodelan prediksi daerah berpotensi endemik berdasarkan pola penyebaran dan karakteristik penyakit	5.1 Model prediksi daerah berpotensi endemik
	6. Pembangunan sistem deteksi dini penyebaran penyakit menular berupa kerangka kerja generik dan panduan penggunaan sistem kerangka kerja.	6.1 Sistem deteksi dini penyebaran penyakit menular

Elemen konsep *design science*	**Tahapan Penelitian**	**Hasil**
Evaluasi artefak	**7. Evaluasi**	**7.1 Hasil evaluasi model pola penyebaran penyakit menular** **7.2 Hasil evaluasi sistem deteksi dini penyebaran penyakit menular**

BAB 5. HASIL DAN LUARAN YANG DICAPAI

5.1. Hasil Penelitian

Hasil penelitian yang telah dicapai adalah sebagai berikut:

1. Model *consumer's behavior* dalam mencari informasi kesehatan melalui media sosial dan mesin pencari. *Consumer* adalah para pasien, keluarga pasien, *caregiver*, dan masyarakat yang mengakses dan menggunakan layanan kesehatan yang bukan professional di bidang medis (*non-medical professionals*) Berdasarkan hasil observasi dan analisis *task*, perilaku *consumer* dapat diklasifikasikan menjadi empat kategori berdasarkan pemahamannya terhadap suatu terminologi kesehatan, yaitu F1, F2, F3, dan F4, dengan L1 adalah kelompok yang awam dengan terminologi kesehatan sampai L4 yang paham dan dapat mengaplikasikan terminologi kesehatan secara tepat dan kontekstual. Setiap kelompok memiliki perilaku spesifik yang diuraikan pada Tabel 5.1 berikut.

Tabel 5.1 Analisis perilaku *consumer* E-health berdasarkan pemahaman terhadap terminologi kesehatan

Kelompok	Analisis Perilaku
F1 (*not familiar*)	▪ Melakukan pencarian dengan mesin pencari Google, Bing. ▪ Kata kunci yang digunakan adalah jenis *lay people vocabulary*, istilah yang umum digunakan dalam percakapan sehari-hari. ▪ Skor efektivitas pencarian rendah. Pencarian dengan kata kunci yang sama dilakukan lebih dari satu kali. Banyak artikel yang diakses, tetapi tidak dievaluasi. Memilih artikel dari hasil pencarian berdasarkan pada posisi artikel di halaman hasil pencarian.
F2 (*somewhat familiar*)	▪ Melakukan pencarian dengan mesin pencari Google, Bing. ▪ Kata kunci yang digunakan adalah jenis *lay people vocabulary*, istilah yang umum digunakan dalam percakapan sehari-hari. Ada modifikasi kata kunci berupa penambahan kata, penggunaan sinonim, dan asosiasi dengan istilah kesehatan yang lain (seperti nama obat, istilah penyakit, dan anggota tubuh). ▪ Efektivitas pencarian lebih baik daripada kelompok

Kelompok	Analisis Perilaku
	F2. Tidak melakukan pencarian dengan kata kunci sama secara berulang-ulang.
F3 (*familiar*)	▪ Melakukan pencarian dengan mesin pencari Google, Bing dan mengakses langsung situs kesehatan yang sering dikunjungi (seperti Medline, WebMD, Halo Dokter). ▪ Kata kunci yang digunakan adalah kombinasi jenis *lay people* dan terminologi kesehatan. Modifikasi kata kunci didasarkan pada pengetahuan dan pengalaman. ▪ Efektivitas pencarian relatif tinggi.
F4 (*very familiar*)	▪ Melakukan pencarian dengan mesin pencari Google, Bing dan mengakses langsung situs kesehatan yang sering dikunjungi (seperti Medline, WebMD, Halo Dokter). ▪ Kata kunci yang digunakan adalah kombinasi jenis *lay people* dan terminologi kesehatan. Modifikasi kata kunci didasarkan pada pengetahuan dan pengalaman. ▪ Skor efektivitas pencarian paling tinggi dari seluruh kelompok. Melakukan *scanning* hasil pencarian untuk menilai relevansi artikel. Mengevaluasi sebagian besar *link* (tautan) artikel yang dibuka.

2. Penyakit menular yang digunakan untuk pengumpulan dan ekstraksi data *online* tahap 1 adalah demam berdarah dengue (DBD), Tuberculosis (TB), dan Difteri. Pemilihan DBD didasarkan pada data Ditjen Pencegahan dan Pengendalian Penyakit Kementerian Kesehatan RI tahun 2016, yang menyatakan bahwa persebaran kasus DBD di Indonesia meliputi 100% provinsi dan 85% kabupaten/kota yang ada di Indonesia. Sementara untuk TB, Indonesia adalah negara dengan jumlah kasus TB terbanyak kedua di dunia berdasarkan data WHO Global Tuberculosis Report tahun 2016. Pemilihan penyakit ketiga, yaitu difteri dilatarbelakangi oleh kejadian luar biasa (KLB) difteri di Indonesia pada tahun 2017.

3. Daftar kata kunci (*keywords*) yang berkaitan dengan demam berdarah dengue, Tuberculosis, dan difteri (Tabel 5.2).

Tabel 5.2 Daftar kata kunci (*keywords*)

No.	Demam Berdarah	No.	Tuberculosis	No.	Difteri
DB-1	demam berdarah dengue	TB-1	tuberculosis	DI-1	difteri
DB-2	demam berdarah	TB-2	TBC	DI-2	diphtheria
DB-3	demam dengue	TB-3	tuberkulosis	DI-3	KLB difteri
DB-4	dengue fever	TB-4	batuk paru	DI-4	vaksin difteri
DB-5	nyamuk aedes	TB-5	rifampisin		
DB-6	aedes aegypti	TB-6	isoniazid		
DB-7	nyamuk demam berdarah	TB-7	ethambutol		

4. Pembuatan dataset dari media sosial Twitter berdasarkan kata kunci dan lokasi. Contoh dataset dapat dilihat pada Tabel 5.3 dan Gambar 5.1.

Tabel 5.3 Potongan dataset Twitter dengan kata kunci "difteri" di wilayah Jakarta dan sekitarnya

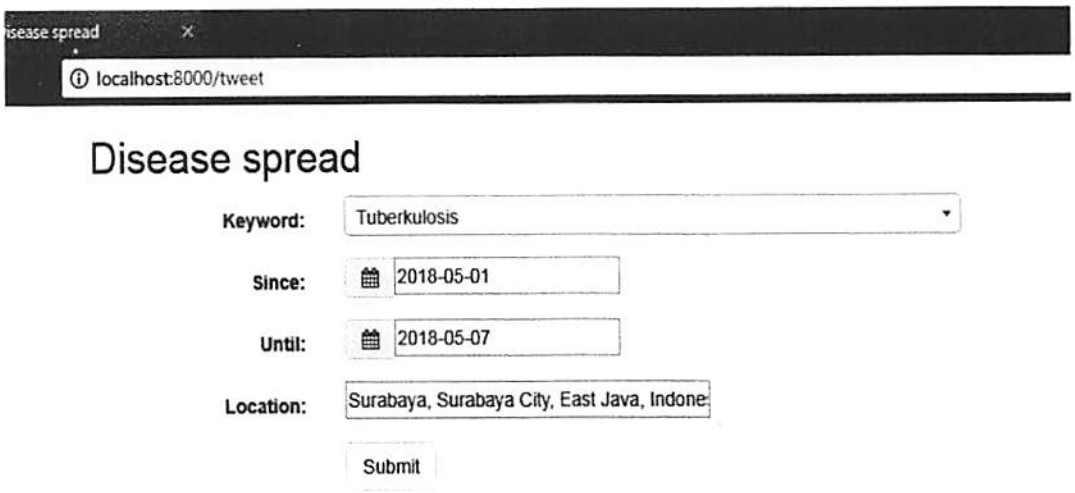
User-name	Tweet	Replies	Retweets	Hashtags	Link and Retweet
DinsosDKI1	Proses suntik difteri bagi WBS Pstw Budi Mulia 1 oleh RS Hermina Galaxi pic.twitter.com/Ohhb2rmOHd	0	0		https://twitter.com/DinsosDKI1/status/1011464130350407680
DinsosDKI1	Penyuluhan Difteri bagi WBS Pstw Budi Mulia 1 disajikan oleh pihak RS Hermina Galaxi pic.twitter.com/Hp92X7lnYa	0	0		https://twitter.com/DinsosDKI1/status/1011458587636318208
SuaraBekasiNews	Venezuela Didesak Hentikan Penyebaran Campak dan Difteri http://dlvr.it/QYDJzQ¬† pic.twitter.com/RKI9XzoNFZ	0	0		https://twitter.com/SuaraBekasiNews/status/1010347474421084160
xeniavanza	Venezuela Didesak Hentikan Penyebaran Campak dan Difteri http://dlvr.it/QYD7NT¬†	0	0		https://twitter.com/xeniavanza/status/1010330356497637376
saatteduhkita	Orang Tua Wajib Tahu! Penyakit Difteri Sedang ,ÃúMewabah,Ãù di Indonesia! Ternyata Ini Lho ,ÃúFaktor Penyebabnya,Ãù!□üòØ□üòØ□üëâ□üëâ□üëâ□üëâ□üëâ Lebih melihat: http://starslife.net¬†#saatteduh #indonesianasia #starlifenet http://starslife.net/?p=8186¬†	0	0	#saatteduh ,#indonesianasia,#starlifenet	https://twitter.com/saatteduhkita/status/1010107659683426304

User-name	Tweet	Replies	Retweets	Hashtags	Link and Retweet
SiwonestShining	Jangan sampe difteri .. Astaghfir	1	0		https://twitter.com/SiwonestShining/status/1009292653182140421
felixleo	@siloamhospitals Suntik Difteri (at @SiloamHospitals in Jakarta Selatan, DKI Jakarta w/ @tarayuningtyas) https://www.swarmapp.com/c/hOMtBMtW9Yk¬†	0	0		https://twitter.com/felixleo/status/977350095032213505
isranurhadi	RT @INABadminton: Hari ini para atlet dan pelatih di pelatnas PBSI Cipayung menjalani vaksin Difteri untuk mencegah terjangkitnya wabah penyakit tersebut. (2) pic.twitter.com/tPebRsw30B	0	0		https://twitter.com/isranurhadi/status/976322258028322816
rsupncm	Hadiri Seminar Awam dengan Tema 'Difteri, Bagaimana Cara Mengenalinya?' dan 'PHBS di Keluarga,Ã¶ https://www.instagram.com/p/BgS0I2DloFj/¬†	0	1		https://twitter.com/rsupncm/status/973811674867171328
swasti_Tee Thaa	Aiko Suntik Difteri dulu yaa... #anakasi #difteri #sehat #sherenalashop #3tahun @ Rawabebek,,Ã¶ https://www.instagram.com/p/BgSeYH8l5Ch/¬†	0	0	#anakasi,#difteri,#sehat,#sherenalashop,#3tahun	https://twitter.com/swasti_TeeThaa/status/973763834371592192
egaviona	Hebat awen di suntik difteri tahap 2 gak nangis good job my daughter @ Shantung https://www.instagram.com/p/BgP9E_ZFP8J/¬†	0	0		https://twitter.com/egaviona/status/973409130168791040
rspuricinere	Vaksin Difteri ke 2 Karyawan Dana Pensiun Mandiri. @ Gedung Bank Mandiri , Mampang Prapatan, https://www.instagram.com/p/BgF5s6TlASp/	0	1		https://twitter.com/rspuricinere/status/971994353416597504
Lucha_macha	Acara seharian kemarin... Suntik vaksin Difteri.. Seminar, https://www.instagram.com/p/BgFQXSLFxP-qiqxej3S7YdWfcdwIgrS4HkDBTs0	0	0		https://twitter.com/Lucha_macha/status/971905011931369472
rspuricinere	Vaksin Difteri ke 2 Guru dan Staf Al-Izhar @ Al Izhar Islamic School https://www.instagram.com/p/BgC87hrlHU2/¬†	0	0		https://twitter.com/rspuricinere/status/971579226028683264
Liyen1245	Suntik difteri baru yg ke 1 masih 2x, habis di suntik lanjut https://www.instagram.com/p/BcPP48bFjat2oycYVHunLXh	0	0		https://twitter.com/Liyen1245/status/955295356685873152

{"contributors": null, "coordinates": null, "created_at": "Tue Oct 10 08:46:08 +0000 2017", "entities": {"hashtags": [], "symbols": [], "urls": [], "user_mentions": []}, "favorite_count": 0, "favorited": false, "geo": null, "id": 917672586036703232, "id_str": "917672586036703232", "in_reply_to_screen_name": null, "in_reply_to_status_id": null, "in_reply_to_status_id_str": null, "in_reply_to_user_id": null, "in_reply_to_user_id_str": null, "is_quote_status": false, "lang": "in", "metadata": {"iso_language_code": "in", "result_type": "recent"}, "place": null, "retweet_count": 0, "retweeted": false, "source": "twittbot.net", "text": "Nyamuk membawa penyakit (malaria, **demam berdarah**, dll). jadi bukan nyamuknya sendiri yang membunuh, tetapi penyakit yang dibawanya.", "truncated": false, "user": {"contributors_enabled": false, "created_at": "Sun May 26 17:53:21 +0000 2013", "default_profile": true, "default_profile_image": false, "description": "#TeamFollowBack #Follow4Follow #ifollowback #follow #back #ifollowback #FollowSeguro #InstantFollow #TFB #P4P #RT #FAV", "entities": {"description": {"urls": []}}, "favourites_count": 110, "follow_request_sent": null, "followers_count": 172, "following": null, "friends_count": 417, "geo_enabled": false, "has_extended_profile": false, "id": 1460270857, "id_str": "1460270857", "is_translation_enabled": false, "is_translator": false, "lang": "en", "listed_count": 4, "location": "#TeamFollowBack ", "name": "Dika name", "notifications": null, "profile_background_color": "C0DEED", "profile_background_image_url": "http://abs.twimg.com/images/themes/theme1/bg.png", "profile_background_image_url_https": "https://abs.twimg.com/images/themes/theme1/bg.png", "profile_background_tile": false, "profile_image_url": "http://pbs.twimg.com/profile_images/508673498965741568/Pm_Kz7_E_normal.jpeg","profile_image_url_https": "https://pbs.twimg.com/profile_images/508673498965741568/Pm_Kz7_E_normal.jpeg", "profile_link_color": "1DA1F2", "profile_sidebar_border_color": "C0DEED", "profile_sidebar_fill_color": "DDEEF6", "profile_text_color": "333333", "profile_use_background_image": true, "protected": false,

Gambar 5.1 Satu datum dalam dataset dengan kata kunci "demam berdarah" dari media sosial Twitter

5. Pembuatan aplikasi ekstraksi data dari media sosial dengan *library Twintproject*, seperti yang ditunjukkan pada Gambar 5.2.



Gambar 5.2 Tampilan Antarmuka Aplikasi Ekstraksi Data Media Sosial Twitter

6. Merevisi daftar kata kunci berdasarkan dataset yang telah diperoleh. Kata kunci yang menjaring banyak *noise* dalam data dihapus dari daftar.
7. Pembuatan dataset 2 dari media sosial Twitter berdasarkan kata kunci dan lokasi. Contoh dataset dapat dilihat pada Tabel 5.4.

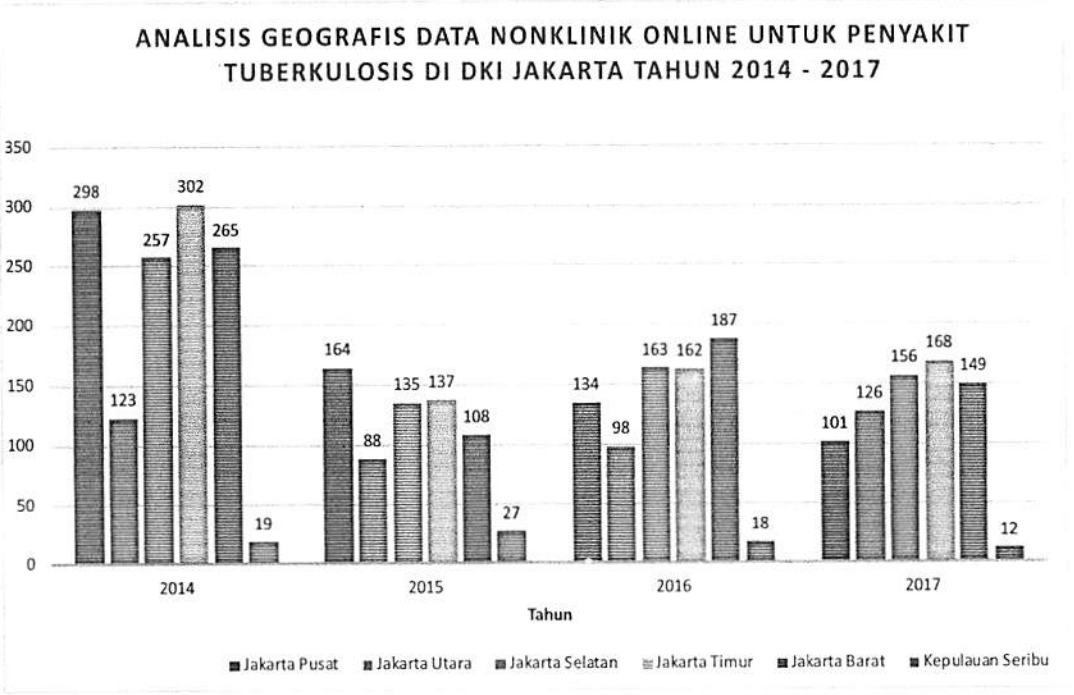
Tabel 5.4 Potongan dataset Twitter dengan kata kunci "difteri" di wilayah Jawa Timur dan sekitarnya

User-name	Tweet	Replies	RT	Hash-tags	link & retweet
brandonizer0	Waspada! Difteri Bisa Berujung Gagal Jantung Hingga Kerusakan SarafJika dibiarkan bisa memicu komplikasi yang sangat parah yang bisa memicu kematian penderitanya...>> http://goo.gl/q8kEKK¬† http://goo.gl/q8kEKK¬†	0	0		https://twitter.com/brandonizer0/status/1011515448909803522
brandonizer0	Sediiih... Curhatan Pilu Ayah yang Putranya Terkena Difteri"...Karena Difteri, adalah dimana kau banyak duit tp tak guna. Salam dari Ayah yg anaknya terserang difteri,"...>> http://goo.gl/a6bS1N¬† http://goo.gl/a6bS1N¬†	0	0		https://twitter.com/brandonizer0/status/1010845527343288321
HertienIndah	Venezuela Didesak Hentikan Penyebaran Campak dan Difteri http://dlvr.it/QYD6q4¬† pic.twitter.com/esg3nexJ5n	0	0		https://twitter.com/HertienIndah/status/1010329360266551296
CrestiSukmadevi	Untuk pencegahan diri sbelum berpergian ke luar negeri,, ada yg butuh :1. Vaksin thyphoid2. Vaksin influenza3. Vaksin difteri dewasa4. Vaksin Yellow feverBisa DM saya langsung..□üòé□üòÅ	0	0		https://twitter.com/CrestiSukmadevi/status/1010193108909191169
NoviaQ	Mereka pernah menemukan c.difteri strain	0	0		https://twitter.com/Novi

User-name	Tweet	Replies	RT	Hash-tags	link & retweet
urrota96	intermedius yg sangat jarang. Kalau memang benar ya hebat tp kita juga mikir apa mereka bener jgn langsung percaya.				aQurrota96/status/10096 25123995783169
NoviaQurrota96	Semboyan qami TS jatimSalam satu difteri ! Wkwkwkwk	0	0		https://twitter.com/NoviaQurrota96/status/10096 22050376306688
hanifnashrullah	musuh generasi muda tak cuma narkoba, tapi juga difteri #imunisasi,Ã¶ https://www.instagram.com/p/BgHz1uIB7EH/¬†	0	0	#imunisasi	https://twitter.com/hanifnashrullah/status/972264 223672807424
RezaSyah68	Apakah kalian sudah disuntik? Difteri merupakan sebuah infeksi yang menyerang selaput lendir,Ã¶ https://www.instagram.com/p/Bf9-9p0n7NL/¬†	0	0		https://twitter.com/RezaSyah68/status/97088000 2274353152
ahmadears	2 video lucu tadi pagi saat anak2 disuntik difteri □üòÅSempet ngumpet lama dikamar mandi hingga,Ã¶ https://www.instagram.com/p/BfxYVuMh1Ov/¬†	0	0		https://twitter.com/ahmadears/status/9691062309 99359488
beritajatimcom	Imunisasi Vaksi Difteri di Bojonegoro Sudah 74 Persen http://dlvr.it/QJ1zDC¬† pic.twitter.com/iCCYOguDl6	0	0		https://twitter.com/beritajatimcom/status/968483 492609732608
coolhake	Suntik Difteri @ SDIT At-Taqwa Surabaya https://www.instagram.com/p/BflROSshMOUxlslOyltnVIUsAQAH3N5lixAtrY0/¬†,Ã¶	0	0		https://twitter.com/coolhake/status/96740172006 1005824
pepphi	LIVE Sehat Selalu Sakti TV with dr. Diah Rahmi, Sp. A. M. Kes Tema : DIFTERI,Ã¶ https://www.instagram.com/p/BfaLJjwgay4/¬†	0	0		https://twitter.com/pepphi/status/965840245659 979776
Sekolah Utsman	Imunisasi Defteri SMP.Sama dngan yang lain, siswq SMP juga mendapatkan,Ã¶ https://www.instagram.com/p/BfZvlnElDTF/¬†	0	0		https://twitter.com/SekolahUtsman/status/965778 637885792256
Sekolah Utsman	Imunisasi Difteri KB TK.Program Imunisasi ini adalah program resmi pemerintah khususnya Kota,Ã¶ https://www.instagram.com/p/BfZRJQ7leq1/¬†	0	0		https://twitter.com/SekolahUtsman/status/965714 166131634177
mbah DBE	#dbe imunisasi difteri @ Sd Kandat 1 https://www.instagram.com/p/Be2BMXahLqg/¬†	0	0	#dbe	https://twitter.com/_mbahDBE_/status/96075180 4765130752
Eris_Chandra89	Hasil jepretan kemarin & imun defteri □üòÇ□üòÇ□üëç□üëç□üëç @ Bumiaji https://www.instagram.com/p/Be1XWz8Fncx9o3AcgNIZNFQEj6UYcC0ujF3LEc0/¬†,Ã¶	0	0		https://twitter.com/Eris_Chandra89/status/96065 9798407680000
nennycha	Bulan imunisasi Difteri.. Mari kenali dan cegah difteri..Apa itu,Ã¶ https://www.instagram.com/p/Bcm_8MfBfTE_OOiMLQt_2HvY2KogQIpqOqG3Hc0/¬†,Ã¶	0	0		https://twitter.com/nennycha/status/9586379951 03539200
ariirizky90	Difteri adalah infeksi bakteri yang umumnya menyerang selaput lendir pada hidung dan,Ã¶ https://www.instagram.com/p/BclsF9_H7Cf/¬†	0	0		https://twitter.com/ariirizky90/status/9404392104 89769984
portalSURYA	20 Guru dan Ratusan Siswa SDIT Ahmad Yani Malang yang Terpapar Difteri Divaksinasi http://dlvr.it/M56FIT¬† pic.twitter.com/v2RdJEXVQ8	0	0		https://twitter.com/portalSURYA/status/7675958 56727904256

8. Pengolahan dan analisis dataset 2.
   a. Membuat kategori data media sosial menjadi tiga kategori yaitu C1,C2, dan C3. Kategori C1 berisi data yang berhubungan dengan penyakit dan deteksinya, kategori C2 berisi data yang memuat kata / frase yang berhubungan dengan penyakit, namun konteks kalimat tidak berhubungan dengan deteksi penyakit tersebut, dan C3 yang berisi data yang memuat kata / frase penyakit, tapi tidak berhubungan dengan objek yang dicari.
   b. Menormalisasi data menggunakan teknik NLP (*Natural Language Processing*).
   c. Pemodelan pola penyebaran penyakit menular berdasarkan data spasial dalam dataset dan metode *conditional random field*. Hasil ini akan dibandingkan dengan model matematika penyebaran penyakit sesuai dengan literatur dan data dari Kementerian Kesehatan.

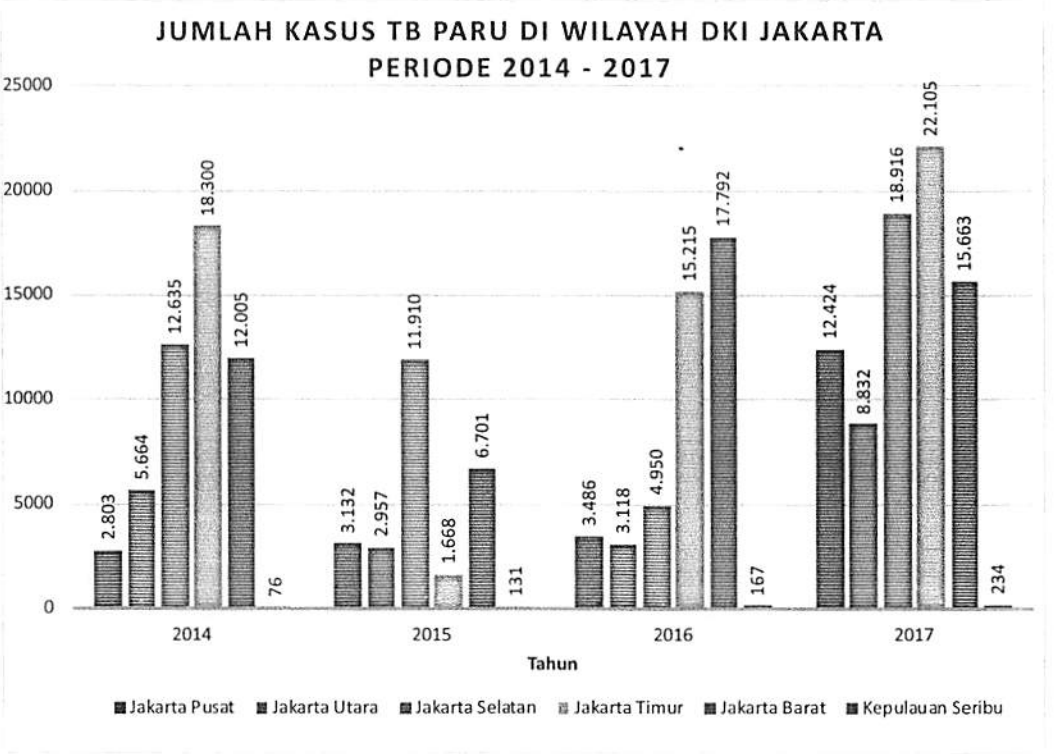
Hasil analisis geografis berdasarkan data nonklinik online untuk penyakit Tuberkulosis di wilayah DKI Jakarta dari tahun 2013 – 208 dapat dilihat pada Gambar 5.3.



Gambar 5.3 Analisis Geografis Data Nonklinik Online DKI Jakarta Tahun 2013 – 2018 untuk Penyakit TB Paru

9. Evaluasi pemodelan pola penyebaran penyakit menular dan evaluasi akurasi model prediksi.

   Analisis geografis data nonklinik online menunjukkan hasil yang berbeda dengan data Kementerian Kesehatan dan Dinas Kesehatan untuk studi kasus wilayah DKI Jakarta periode 2014 – 2017. Hal ini disebabkan oleh perbedaan karakteristik user / pengguna media sosial. Tidak semua pengguna media sosial yang menulis berita / status tentang TB Paru adalah penderita. Namun, data nonklinik tersebut dapat menunjukkan adanya situasi yang tidak normal. Contohnya, pada tahun 2014, data nonklinik penyakit TB di media sosial mencapai puncaknya dengan data paling banyak di lokasi Jakarta Pusat dan Jakarta Timur. Sementara itu, data dari Dinas Kesehatan DKI Jakarta (Gambar 5.4) pada tahun 2014, jumlah kasus TB terbanyak berada di wilayah Jakarta Timur dan Jakarta Selatan.



Gambar 5.4 Grafik Jumlah Kasus TB Paru di Wilayah DKI Jakarta Periode 2014 - 2017
(Sumber: Dinas Kesehatan DKI Jakarta)

Hasil dan capaian penelitian secara lengkap tersaji pada Tabel 5.5.

Tabel 5.5 Hasil dan capaian penelitian tahun kedua

No.	Kegiatan	Hasil	Realisasi Capaian
1.	Inisialisasi		
	Studi Literatur	Analisis studi literatur untuk identifikasi permasalahan kritikal di bidang kesehatan, limitasi dari solusi yang telah ada, dan bagaimana pemanfaatan sistem dan teknologi informasi dapat membangun solusi yang lebih efektif. Studi literatur membentuk basis pengetahuan yang relevan terhadap penelitian yang dikerjakan dengan cara mengeksplorasi konsep *disease surveillance*, konsep *wisdom of crowds* dan teknologi berbasis komunitas, pola penyebaran penyakit, dan permodelan prediksi.	100%
2.	Observasi perilaku pengguna Internet dalam mencari dan mengakses informasi kesehatan *online*	a. Model perilaku pengguna Internet dalam mencari dan mengakses informasi kesehatan. b. Analisis perilaku *health informationg search online* berdasarkan tingkat pemahaman terhadap topik kesehatan yang dicari.	100%
3	Pembuatan aplikasi untuk pengumpulan dan ekstraksi dataset	Sumber dataset adalah media sosial Twitter dan Facebook. Aplikasi yang dibuat menggunakan *library* Twitter Twint project (https://github.com/twintproject).	100%
4.	Pengumpulan dan Ekstraksi Data 1		
	a. Penyusunan daftar kata kunci 1 yang terkait dengan penyakit menular yang dianalisis	Daftar kata kunci terkait dengan demam berdarah dengue (*keywords* DBD) dan Tuberculosis (*keywords* TB).	100%
	b. Ekstraksi data dan penyusunan dataset 1.	Dataset 1 dari status Twitter yang mengandung minimal satu kata	100%

No.	Kegiatan	Hasil	Realisasi Capaian
		kunci dari *keywords* DBD atau *keywords* TB.	
5.	Pengumpulan dan Ekstraksi Data 2		
	a. Penyusunan daftar kata kunci 2 yang terkait dengan penyakit menular yang dianalisis	Daftar kata kunci terkait dengan difteri.	100%
	b. Ekstraksi data dan penyusunan dataset 2.	Dataset 2 dari status Twitter yang mengandung minimal satu kata kunci dari *keywords* difteri.	100%
6.	Pengolahan dan Analisis Data		100%
7.	Evaluasi		100%

5.2. Luaran Penelitian

Luaran penelitian yang telah dicapai adalah sebagai berikut.

1. Publikasi Ilmiah 1, materi publikasi ilmiah 1 adalah analisis perilaku penggunaan media sosial untuk aktivitas *e-patient* dan aktivitas kesehatan lainnya, termasuk akses dan permintaan layanan dan informasi kesehatan untuk penyakit menular.

Nama jurnal yang dituju:	Health Information and Libraries Journal URL: https://onlinelibrary.wiley.com/journal/14711842
Klasifikasi jurnal:	Jurnal internasional bereputasi (Q1)
Impact factor jurnal:	1.91
Judul artikel:	Characterizing Consumer Behavior in Leveraging Social Media for E-Patient and Health-Related Activities
Status naskah:	***In Revision***

2. Publikasi Ilmiah 2, materi publikasi ilmiah 2 adalah verifikasi metode penelitian yang digunakan, yaitu *design science research*.

Nama jurnal yang dituju:	International Journal of Business Information System URL: www.inderscience.com/ijbis
Klasifikasi jurnal:	Jurnal internasional bereputasi
Impact factor jurnal:	Q3
Judul artikel:	Making the Information Technology (IT) – Business Alignment Works: A Framework of IT-based Competitive Strategy
Status naskah:	***Accepted***, menunggu dipublikasikan. DOI: 10.1504/IJBIS.2020.10015159 URL:http://www.inderscience.com/info/ingeneral/forthcoming.php?jcode=IJBIS

3. Publikasi Ilmiah 3, materi publikasi ilmiah 3 adalah verifikasi metode analisis yang digunakan, yaitu penerapan model analisis *structural equation modeling*.

Nama jurnal yang dituju:	Journal of Information Systems Engineering and Business Intelligence URL: https://e-journal.unair.ac.id/JISEBI
Klasifikasi jurnal:	Jurnal nasional terakreditasi
Impact factor jurnal:	---

Judul artikel:	The Continuance Intention of User's Engagement in Multiplayer Video Games based on Uses and Gratifications Theory
Status naskah:	***Published***

4. Pembicara dan pemakalah pada Temu Ilmiah (Seminar/Simposium) Internasional

Judul Makalah:	A User-centered Design for Redesigning E-Government Website in Public Health Sector
Nama Temu Ilmiah:	3rd International Seminar on Application for Technology of Information and Communication
Tempat:	Universitas Dian Nuswantoro, Semarang, Indonesia
Waktu Pelaksanaan:	21-22 September 2018
Status:	Sudah dilaksanakan

5. Hak Kekayaan Intelektual (HKI): Hak Cipta 1

Judul HKI:	Stakeholder's Expected Value of Enterprise Architecture, An Enterprise Architecture Solution based on Stakeholder Perspective
Jenis:	Hak Cipta
No. Pendaftaran:	EC00201810658
Tahun Pendaftaran:	2018
Status:	***Granted***, No. HKI: **000107337**

6. Hak Kekayaan Intelektual (HKI): Hak Cipta 2

Judul HKI:	The Impacts Of Consumer's Health Topic Familiarity In Seeking Health Information Online: A Solution Based On Consumer's Perspective In Health Information Search
Jenis:	Hak Cipta
No. Pendaftaran:	EC00201816854
Tahun Pendaftaran:	2018
Status:	***Granted***, No. HKI: **000111047**

7. Luaran Lain: Prototipe

Judul Luaran:	**Aplikasi Ekstraksi Data Nonklinik Online Twitter**
Deskripsi:	**Aplikasi yang dikembangkan untuk mengekstraksi data nonklinik dari media sosial Twitter. Data yang diekstraksi adalah data Twitter yang mengandung kata kunci spesifik (penyakit menular), data geolokasi, dan user. Keluaran berupa data media sosial yang akan diolah lebih lanjut untuk menganalisis pola penyebaran penyakit menular**

BAB 6. KESIMPULAN DAN SARAN

6.1. Kesimpulan

Model perilaku pengguna Internet dalam bidang kesehatan telah dibuat sesuai dengan pengumpulan dan hasil analisis data selama kurun waktu empat bulan. Model ini diperlukan sebagai prasyarat kelayakan topik penelitian yang memodelkan penyebaran penyakit menular berdasarkan data nonklinik *online* dari media sosial. Sesuai dengan hasil observasi perilaku pengguna Internet, semakin banyak pengguna Internet yang memanfaatkan media sosial dan mesin pencari kesehatan untuk mengaskses dan berbagi informasi kesehatan.

Salah satu cara untuk menekan laju penyebaran menular adalah dengan memanfaatkan data nonklinik *online* untuk mengalisis pola penyebaran penyakit menular dan deteksi daerah potensi endemik penyakit menular secara lebih cepat, bahkan *real time*. Diharapkan dengan penggunaan teknologi informasi untuk *disease surveillance* di Indonesia, hasil penelitian ini dapat menjadi solusi yang aplikatif dalam pemberantasan penyakit menular di Indonesia.

6.2. Saran

Saran untuk kelanjutan penelitian ini adalah:

1. Merevisi daftar kata kunci yang terkait dengan penyakit menular yang dipilih. Daftar kata kunci meliputi nama penyakit menular dalam bahasa Indonesia dan bahasa Inggris, termasuk istilah populer yang lazim digunakan di masyarakat. Hal ini disebabkan sifat personal dan penggunakan bahasa populer di media sosial.
2. Menyempurnakan dataset yang akan dianalisis dengan mengurangi *noise* dan melakukan *preprocessing* data.

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LAMPIRAN 1 Luaran Penelitian 1: Jurnal Internasional Bereputasi

Luaran penelitian 1 adalah artikel ilmiah yang di-*submit* ke Health Information and Libraries Journal.

Nama jurnal yang dituju:	Health Information and Libraries Journal URL: https://onlinelibrary.wiley.com/journal/14711842
Klasifikasi jurnal:	Jurnal internasional bereputasi (Q1)
Impact factor jurnal:	1.91
Judul artikel:	Characterizing Consumer Behavior in Leveraging Social Media for E-Patient and Health-Related Activities
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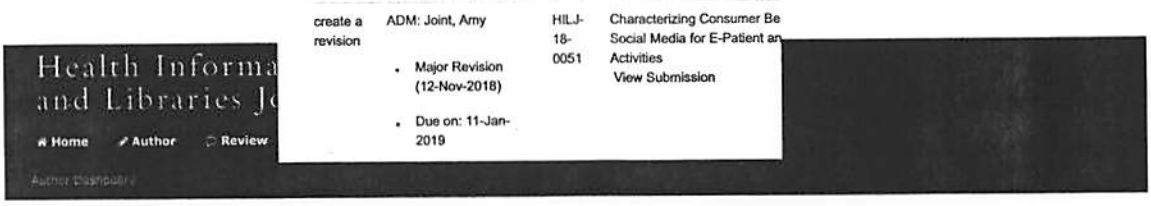

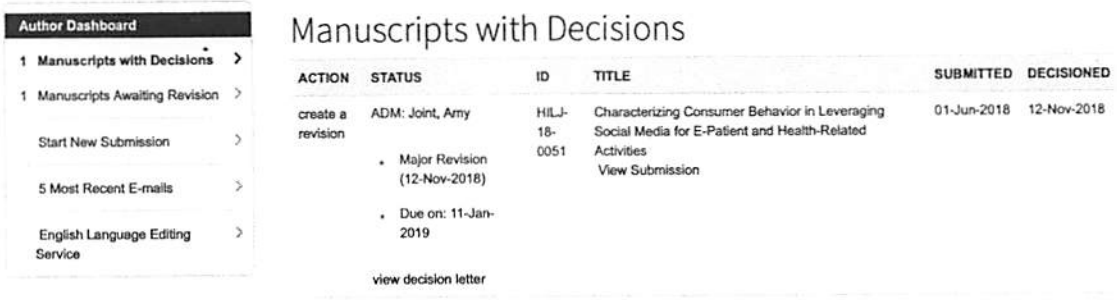

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Characterizing Consumer Behavior in Leveraging Social Media for E-Patient and Health-Related Activities

Journal:	*Health Information and Libraries Journal*
Manuscript ID	HILJ-18-0051
Manuscript Type:	Original Article
Keywords:	Consumer health information, Information seeking behaviour, Patient education, Health information needs, Information and communication technologies (ICTs), Information dissemination, Social media, Social networking, South East Asia

Abstract:

Background
The evolution of social media and the emergence of the e-patient movement have encouraged consumers to use social media for e-patient activities. However, the nature of social media and the lack of regulation have caused reliability and trustworthiness problems.

Objectives
This study aims to examine the consumer behavior in leveraging social media for e-patient activities and to identify the contributing factors that could improve the quality of social media utilization.

Methods
This study explores consumer behavior based on The Unified Theory of Acceptance and Use of Technology and the Protection Motivation Theory integration model. The data collected from the participants was analyzed using Covariance-based Structural Equation Modelling.

Findings
The results showed that perceived usefulness, perceived ease of use, perceived severity, response efficacy, and response cost had significant impacts on behavioral intention. Behavioral intention also positively corresponded to usage intention. Based on the findings, this study recommends initiatives to expand the social media utilization for promoting a healthy life style and educating society about healthcare management.

Conclusion
The consumer behavior towards adopting social media for e-patient activities is affected by technical and social factors. The identification of contributing factors is beneficial to facilitate a more reliable online health communication.

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Keywords

Consumer behavior, e-patient, social media for health-related activities, social media, leveraging social media for e-patient

Key Messages

- The rising use of social media for health-related purposes has raised some concerns related to reliability and trustworthiness about the health information being shared.
- Understanding the consumer behavior is necessary to identify the underlying factors and to improve online health communication quality based on the identified factors.
- This study demonstrates the application of UTAUT and PMT integration model to examine consumer behavior in leveraging social media for e-patient activities.
- The intention to use social media is more likely driven by awareness to prevent health problems than reactions to the risk of developing an illness.
- Consumer and health information provider could make greater use of social media to raise awareness about a healthy lifestyle and proactive health care management

Introduction

The emergence of e-patient activities has encouraged consumers, non-medical experts, to be more engaged in healthcare needs by utilizing online sources via social media (Buchanan & Beckett, 2014; Grajales, Sheps, Ho, Novak-Lauscher, & Eysenbach, 2014; Househ, Borycki, & Kushniruk, 2014; Song et al., 2016) both health related social medias (e.g., Patientslikeme.org) and general social medias (e.g., Facebook, Twitter, Instagram, Youtube, and blogger). Examples of e-patient activities on social media include participation in online health communities, access to consumer-friendly health information and health education, sharing experiences about disease treatment and other health issues, personalized interaction with medical professionals, and access to telemedicine. Researchers have incorporated consumer participation in social media in their studies mainly to detect and trace outbreaks (Nsoesie et al., 2016; Santillana et al., 2015; Simonsen, Gog, Olson, & Viboud, 2016; Yom-Tov, Borsa, Cox, & McKendry, 2014), to improve disease surveillance systems using infodemiology data (Broniatowski, Paul, & Dredze, 2013; Nagar et al., 2014; Nsoesie et al., 2016; Santillana et al., 2015; Seo et al., 2014), to recruit participants in online studies and clinical trials (Attai et al., 2015; Liu & Yu, 2013; Zhang, Brackbill, Yang, & Centola, 2015), and to improve medication management (Househ et al., 2014; Lee, Agrawal, & Choudhary, 2015; Välimäki, Athanasopoulou, Lahti, & Adams, 2016; Zhang et al., 2015). Patients with serious mental illness reported benefits from participating in online communities to promote mental health care seeking behaviors (Naslund, Aschbrenner, Marsch, & Bartels, 2016). The QuitNet community, one of the largest online communities for behavior change, helps its members to quit smoking by providing social support and intervention (An et al., 2008). In another study, Lo, Esser, & Gordon (2010) suggested that video sharing website, such as YouTube, enabled the alteration of misinformation and stigma about epilepsy.

Indonesia is one of the largest social media users worldwide (#1in1Social, n.d.; Statista, 2018). In line with the rising global awareness of e-patient activities, Indonesians have recently been utilizing social media for health communication. For example, *Forum Jejaring Peduli AIDS*, is an online community of ambassadors and HIV/AIDS care organizations in Indonesia (Laksono, Ratna, & Wulandari, 2011). The community uses Facebook to facilitate information sharing and discussion among members, to promote empowerment for people living with HIV/AIDS, and to educate society about HIV/AIDS.

However, the use of social media for health-related purposes has raised some concerns pertaining to reliability and trustworthiness (Dalmer, 2017; Song et al., 2016; Tunnecliff et al., 2015). All social media users are able to create, disseminate, access, and apply health information content both as the content producer and/or the consumer. As the content producer, the users create, and post health material based on their own / family experiences and medical history. The results vary in accuracy and quality because oftentimes the writing process lacks proper evaluation and/or rigorous review from the reputable institution. While this type of health communication might help others who share similar condition, it also comes with unfavorable consequences for the consumers, such as excessive fear and unwise health decision-makings because what applies to an individual may not work for others. In addition, since anyone can be a content producer, selecting reliable and trustworthy materials on social media becomes more arduous. This situation increases the likelihood of misunderstanding and/or misinterpretation of health information. This may lead to serious impacts on individual and family health (I. Puspitasari, 2017; I. Puspitasari, Fukui, Moriyama, & Numao, 2014).

This study explores consumer behavior in leveraging social media for health communication from the technical and social perspectives. We adapted the integration theories of The Unified Theory of Acceptance and Use of Technology (UTAUT) and Protection Motivation Theory (PMT) by Hsieh, Kuo, Wang, Chuang, & Tsai (2016). The goals were to identify the contributing factors that could improve the quality of online health communication and to propose recommendations for social media use that facilitate e-patient and other health-related activities.

Materials and Method

Hypothesis Development

The first hypotheses set considers the user's self-efficacy and the Technology Adoption Model (TAM) framework's key factors of technology adoption, i.e., perceived usefulness (PU) and perceived ease of use (PEOU). Self-efficacy refers to the sense of confidence in one's ability to succeed in accomplishing a task. Confident and skillful users accomplish a task more frequently, thus the user perceives more benefits from using a system. Previous studies have also demonstrated that self-efficacy positively influenced PU and PEOU (Chiu & Tsai, 2014; J. Kim & Park, 2012; Liaw & Huang, 2013). The first hypotheses set includes:

H1: Self-efficacy has a positive impact on perceived usefulness.

H2: Self-efficacy has a positive impact on perceived ease-of-use.

According to the UTAUT framework, PU and PEOU influence intention to use a technology, including Health Information Technology (HIT). Prior studies have demonstrated that PU and PEOU were positively correlated with behavioral intention, such as HIT acceptance in a specific region (Aldosari, 2012), wearable technology in health care (Gao, Li, & Luo, 2015), and mobile technologies (Hoque & Sorwar, 2017; S. Kim, Lee, Hwang, & Yoo, 2015). Similarly, subjective norms, the indicator of social influence that affects a person's use of HIT, also impact intention to use a technology (J. D. Jackson, Yi, & Park, 2013; Ketikidis, Dimitrovski, Lazuras, & Bath, 2012; Sun, Wang, Guo, & Peng, 2013). Thus, the following hypotheses are applicable:

H3: Perceived usefulness has a positive impact on behavioral intention.

H4: Perceived ease-of-use has a positive impact on behavioral intention.

H5: Subjective norms have a positive impact on behavioral intention.

Protection Motivation Theory (PMT) postulates that threat and coping appraisal motivate an individual to undertake self-protection behavior. The PMT model has been applied to examine health related behavior and intention, for example how to change the attitude of embracing healthier living, how to quit smoking (ref), and how to deal with specific diseases (ref). Despite its widely application in health behavior interpretation or social media usage, the study of PMT model on social media for health communication is rather limited. Previous studies in PMT indicated that the threat appraisal factors, i.e., perceived severity and perceived susceptibility, positively impacted the intention to use a system (Gao et al., 2015; Vance, Siponen, & Pahnila, 2012). When facing a relatively unknown or significant threat, users tend to develop a positive attitude to prevent the threat from happening or to lessen the risk of threat. Similarly, coping factors, i.e., self-efficacy and response-efficacy, also significantly influence behavioral intention (Anderson & Agarwal, 2010; Siponen, Adam Mahmood, &

Pahnila, 2014). When a user decides to adopt a technology or system, he/she considers the effort and time to learn how to use the system and how to achieve satisfactory productivity. Therefore, a high response cost hinders technology / system adoption (Anderson & Agarwal, 2010; Vance et al., 2012). Applying the result from PMT applications, the following set of hypotheses are applicable:

H6: Perceived severity has a positive impact on behavioral intention.

H7: Perceived susceptibility has a positive impact on behavioral intention.

H8: Self-efficacy has a positive impact on behavioral intention.

H9: Response-efficacy has a positive impact on behavioral intention.

H10: Response-cost has a negative impact on behavioral intention.

H11: Behavioral intention has a positive impact on usage behavior.

Figure 1 shows the research model of this study.

Data Collection

We conducted a purposive sampling to recruit the study participants. The recruited participants were non-medical professionals with a minimum age of 18 years, had membership in at least one social media platform (e.g., Twitter, Facebook, Instagram, Blogger, etc.), and had experience using social media for e-patient activities, such as such as: sharing and discussing health materials, having consultation with physicians, and searching for specific health information. The profile of the participants included undergraduate students, graduate students, professionals, entrepreneur, and housewife.

The data was collected using paper-based and web-based questionnaires that consisted of demographic profile and behavioral questions. Both questionnaires were identical. The questions related to UTAUT were adapted from Venkatesh, Morris, Davis, & Davis (2003), while the questions pertaining to PMT were adapted from Hsieh et al. (2016); Greene, Rubin, Hale, & Walters (1996); and Sun-Young Lee, Hwang, Hawkins, & Pingree (2008). Before the data collection, one public health expert and one health informatics expert assessed the content validity of a draft questionnaire. We revised the draft according to the experts' feedback. Subsequently, the questionnaires were given to the participants. The data was collected between June and September 2017. The completed questionnaire is provided at Appendix A.

Analysis Model

The data collected from the participants was tabulated using descriptive statistical analysis that included demographic profile and participants' answers. The validity and the reliability of the questionnaire's indicators were tested using Pearson Correlation Product and Cronbach's Alpha. To describe the user's behavior in using social media for online health communication, we developed a covariance based structural equation model (CB-SEM). All data was checked against the SEM assumptions using a multivariate outliers test and a normality test. A Confirmatory Factor Analysis (CFA) was performed to examine convergent validity and discriminant validity and to measure model goodness of fit. Convergent validity tested whether the expected related constructs shared a high proportion of variance in common, while discriminant validity tested the degree of a single construct and whether it was distinct from other constructs in the model. Provided that all model's constructs were reliable and

valid, the next step was developing the structural model to examine the relationships among hypothesized latent constructs and observable variables.

Results

Participant Profile

A total of 324 responses were initially collected from across Indonesia. After discarding invalid and incomplete responses, the number of valid questionnaires was 292. The sample size was considered sufficient based on maximum likelihood estimation with multivariate normal data (D. L. Jackson, 2001). The majority of the participants were female (63%, n=185). This gender profile was in line with a previous study that reported that women were more engaged in searching for health information on the Internet than men (Bidmon & Terlutter, 2015). Around half of the participants were aged between 18 - 27 years (48.29%, n=141) and had logged in to social media for more than six years (64%, n=188).

The top four popular social media platforms used by the participants were Instagram (31.85%, n=236), YouTube (22,95%, n=170), social blogging sites (18.08%, n=134), and Facebook (14.98%, n=111). Other social media included Twitter, Line, Pinterest, LinkedIn, and ask.fm. The participants used social media to engage in health-related discussion and communication mostly on the topics of disease information (31.55%, n=260), medicine (21.72%, n=179), and diet (16.50%, n=136). Table 1 shows the demographic profile and Table 2 presents the distribution of social media usage among the participants.

Validity and Reliability Analysis

The internal consistency of the questionnaire was tested using Pearson Correlation Product and Cronbach's Alpha, as shown in Table 3. All indicators exhibited a significance < 0.05 and a Cronbach's Alpha < 0.7, indicating a favorable internal consistency.

Multivariate Normality and Outliers

The most common technique in SEM assumes multivariate normality. This study evaluated the multivariate normality based on maximum likelihood estimation (MLE). In a normal distribution, the critical ratio value of both skewness and kurtosis ranged from -2.58 to +2.58 (Ullman, 2006). The critical ratio value in this study's normality evaluation was 0.722, indicating a normal distribution.

The next assumption in CB-SEM is the absence of multivariate outliers. This study evaluated multivariate outliers using Mahalanobis distance. The outliers were detected if the Mahalanobis distance was greater than a specified critical distance, the chi-square (Tabachnick & Fidell, 2013). The chi-square value in this evaluation was 58.3012 ($p < 0.001$; df: the number of indicators = 29). All data generated Mahalanobis distance less than the chi-square, as shown in Table 4, thus there were no multivariate outliers detected in this dataset.

Measurement Model

This study executed CFA to evaluate the convergent and discriminant validity of the latent variables with the observed variables. The constructs exhibited convergent validity if the loading factor value was > 0.5, the Composite Reliability (CR) was > 0.7, and the Average Variance Extracted (AVE) was > 0.5 (Hair Jr., Black, Babin, & Anderson, 2010). For all constructs, the loading factor ranged from 0.850 to 0.927, the CR ranged from 0.918 to 0.966, and the AVE ranged from 0.816 to 0.902, as shown in Table 3; hence, all constructs exhibited convergent validity.

The discriminant validity of the construct was satisfied if the correlation between latent constructs was greater than $\sqrt[3]{AVE}$ (Hair Jr. et al., 2010). The result in Table 5 shows that the correlation value between two constructs was less than the square roots of the AVE of each construct, indicating a favorable discriminant validity.

Structural Model

The developed structural model in this study is shown in Figure 2. We analyzed the structural model using IBM SPSS AMOS (Arbuckle, 2013). To evaluate the structural model, we conducted overall goodness of fit (GoF) test between the model and the data using the indicators absolute fit indices, incremental fitness indices, and parsimonious fit indices. The result of GoF of model in Table 6 indicated a sufficient overall model fit (Xiong, Skitmore, & Xia, 2015).

Hypothesis Testing Results

We analyzed the model and hypothesis testing based on the structural model evaluation results (Figure 2). According to the path analysis between self-efficacy and PU (path coefficient = 0.697; $p<0.001$), self-efficacy correlated positively with PU, which supported H1. A similar result between self-efficacy and PEOU (path coefficient = 0.769; $p< 0.001$) also suggested that high self-efficacy was correlated with high PEOU. This result validated H2. PU and behavioral intention exhibited positive correlation with a path coefficient of 0,136 and $p<0.05$, suggesting that high PU corresponded to high behavioral intention, thus verifying H3. A similar result between PEOU and behavioral intention (path coefficient = 0.137; $p<0.05$) also revealed that high PEOU correlated with high behavioral intention, therefore signifying H4. On the contrary, there was limited correlation between subjective norms and behavioral intention, as demonstrated by a path coefficient of 0.066 and $p>0.05$. This result invalidated H5.

For the next set of hypotheses, high perceived severity corresponded with high behavioral intention as exhibited by a path coefficient of 0.189 and $p<0.001$, thus confirming H6. On the other hand, perceived susceptibility did not correspond to behavioral intention (path coefficient = 0.085; $p>0.05$), nullifying H7. Similarly, self-efficacy demonstrated limited correlation with behavioral intention, as shown by a path coefficient of 0.106 and $p>0.05$, thus invalidating H8.

High response efficacy generated high behavioral intention with a path coefficient of 0.126 and $p<0.05$, which confirmed H9. Response cost exhibited negative correlation with behavioral intention (path coefficient = 0.127;

p<0.05), thus signifying H10. A high level of behavioral intention corresponded to a high level of usage intention as demonstrated by a path coefficient of 0.816 and p<0.001, confirming H11. The hypothesis testing results are summarized in Figure 3.

Discussion

Consumer Behavior Towards Adopting Social Media for E-patient Activities

The positive correlation in H1 and H2 reveals that consumers who are confident and familiar with their skill tend to achieve their goals and employ less effort to engage in online health communication, and thus experience more benefits. This finding is in line with other studies on online health information sharing behavior that reported that consumers with a higher level of familiarity were likely to achieve higher search efficiency (Ira Puspitasari, Moriyama, Fukui, & Numao, 2015).

Another interesting finding is how the usefulness and the ease of use affect consumer's behavioral intention, as shown in H3 and H4. Consumers develop their intention to continue using a system if they experience beneficial impacts on their work or situation. With social media, consumers perceive additional benefit in accessing more extensive healthcare providers and health material and connecting to world-wide health communities. Likewise, the ease of use of a system encourages consumers to explore further about the system's functionality. They continue using and exploring social media to discover more advantages in e-patient and health-related purpose. On the other hand, the perception of peers' (family members, friends) beliefs does not affect the intention to use social media for health communication, as shown by H5 rejection. This finding is in contrast to a prior study that reported social pressure influenced social media utilization (Gruzd, Staves, & Wilk, 2012). Social media has evolved as one of the primary communication channels for most Internet users, therefore its usage tends to be driven by necessity rather than social influence.

The positive correlation in H6 reveals that consumers who are aware of the consequences of a health problem tend to engage in preventative behavior. While consumers tend to lessen health communication or e-patient activities via social media when they perceive developing a health problem, as demonstrated by H7 rejection. Consumers with high-perceived susceptibility attempt to cope with their fear by avoiding exposure to the source of their fear, i.e., disease-related messages. In the case of self-efficacy and behavioral intention, the H8 rejection implies that the consumer's confidence does not affect the user's willingness to use social media for health communication. Consumers with high self-efficacy tend to be more aware about unfavorable issues. They tend to be skeptical of the reliability and the trustworthiness of the health information they found online (Chaudhuri, Le, White, Thompson, & Demiris, 2013; Fischer, David, Crotty, Dierks, & Safran, 2014). Therefore, users may cautiously use social media for health communication despite their confidence of using the system.

The result of H9 reveals that adopting specific behavior that is perceived to be effective in reducing a health problem affects the consumer's usage intention. Based on the questionnaire results, the participants who had experienced the benefits of social media were likely to maintain their intention of using the system. The negative correlation in H10 implies that the intention to use social media for health-related activities declines

when the associated cost is perceived to be high. The intention to use a system greatly impacts on its usage, as demonstrated in H11. The stronger the intention is, the higher the usage intensity is.

Implications and Recommendations for Leveraging Social Media for E-Patient Activities

Based on the hypothesis testing results, perceived usefulness, perceived ease of use, perceived severity, response efficacy, and response cost have significant impacts on behavioral intention. The strong PU and PEOU suggest the anticipated convenience and benefit obtained from using social media for health-related purposes. Behavioral intention is likely to increase if social media promotes ease of use and provides more advantages to the consumers. Promoting ease of use concerns not only how to use the system, but also how to interpret the health information, for example by providing a health terminology dictionary and organizing health content based on specific categories.

In addition, the hypothesis testing results indicate that the intention to use social media for health-related purposes is driven by awareness to prevent a health problem rather than a reaction to the risk of developing an illness. This could be explained by the intense cautiousness when a consumer perceives the possibility of developing health problems. Consumers may avoid using social media because they fear the truth pertaining to their health problems or they are skeptical about the accuracy of the health information on social media. This finding suggests the greater need for the promotion and the provision of reliable and trustworthy health information on social media. Some possible strategies include involving medical professionals in the assessment of information quality, requiring credible sources to be used, linking to an accredited health institution, and requiring health content producers to be certified by a legitimate institution.

Based on the result on the coping appraisal factors, the participants believed that engaging in health-related activities on social media has helped them to achieve their goals. A high response efficacy could diminish the response cost associated with utilizing a system. These factors could motivate consumers to keep using social media for health-related purposes. Drawing on this finding, all parties, both consumers and providers, could make greater use of social media to raise awareness about a healthy lifestyle and proactive health care management. Health care providers and government health agencies could utilize social media for promoting healthy life style, providing high quality health materials, opening online consultation and interactive discussion with medical professionals, and facilitating e-patient communities.

While most of the results correspond to the goals of this study, future researches in consumer behavioral study are required for further validation. First, applying and combining other information system theory and user behavioral model could provide valuable insight pertaining to the characterization of e-patient engagement in social media. Second, a further investigation on how the participant's background affects the behavior should be addressed in the next study to explore more significant contributing factors. Third, the participants in this study shared the same country of origin, thus the future researches are recommended to include a more comprehensive study involving participants from heterogenous background. The cultural trait attribute may affect the consumer's behavior in communicating and disclosing health information online.

Conclusion

This study examines consumer behavior in leveraging social media for health-related activities from the technical and social perspectives. The significant factors that influence the usage of social media for health-related purposes are perceived usefulness, perceived ease of use, perceived severity, response efficacy, and response cost. Behavioral intention also positively corresponded to usage intention. Among the participants, engaging in health communication using social media was motivated by the act of prevention rather than an attempt to remedy. One of the possible causes is the trustworthiness and reliability of health information shared on social media. Based on the findings, this study recommends strategies and initiatives to improve the usage intention level to utilize social media for health communication, as it is one of the most accessible ways to promote a healthy life style and to educate about proactive health care and management to society at large.

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Table Legends

Table 1: Distribution of participants by demographic profile

Table 2: Social media platform and type of e-patient activities in social media

Table 3: Internal Consistency and Convergent Validity Analysis

Table 4: Multivariate Analysis Test. The outliers were detected if the Mahalanobis distance > a specified critical distance (χ^2). $\chi^2 = 58.3012$; $p<0.001$; df: the number of indicators = 29.

Table 5: Discriminant validity test

Table 6: Goodness of fit

Figure Legends

Figure 1: The research model to characterize the consumer behavior in leveraging social media for e-patient and health-related activities. The model was constructed based on the integration theories of Protection Motivation Theory (PMT) and The Unified Theory of Acceptance and Use of Technology (UTAUT).

Figure 2: The structural model

Figure 3: The final proposed model based on covariance-based structural equation modeling. Perceived usefulness, perceived ease of use, perceived severity, response efficacy, and response cost had significant impacts on behavioral intention. Behavioral intention also positively corresponded to usage intention.

Appendix A Questionnaire

Appendix A provides the questionnaire in detail.

Table 1 Distribution of participants by demographic profile

Category	N (%), N=292
Gender	
Male	107 (36.64)
Female	185 (63.36)
Age	
18 – 27 years	141 (48.29)
28 – 37 years	96 (32.88)
38 – 47 years	30 (10.27)
48 – 57 years	18 (6.16)
> 57 years	7 (2.40)
Occupation	
Student: high school / undergraduate / graduate	101 (34.59)
Professional	98 (33.56)
Entrepreneur	56 (19.18)
Housewife	25 (8.56)
Other	17 (5.82)
Social media period of use	
< 1 year	3 (1.03)
1 – 3 years	17 (5.82)
4 – 6 years	84 (28.77)
> 6 years	188 (64.38)

Table 2 Social media platform and type of e-patient activities in social media

Category (N=292)	N	Percent of participants[a]
Social Media platform(s)		
Instagram	236	80.82
YouTube	170	58.22
Web blog	134	45.89
Facebook	111	38.01
Twitter	58	19.86
Other	32	10.96
E-patient and health-related activities in social media		
Health information search and discussion about specific disease	260	89.04
Health information search and discussion about specific medicine	179	61.30
Health information search and discussion about diet plan	136	46.58
Access to medical professionals and health institution contact	100	34.25
Nutrition plan	77	26.37
Health information search and discussion about pregnancy	41	14.04
Access to health insurance provider	20	6.85
Other	11	3.77

Note: [a]the participant was permitted to select more than one answer

Table 3 Internal Consistency and Convergent Validity Analysis

Variable	Indicator	Validity (sig<0.05 (α=5%))			Reliability (>0.7)		C.R.[a] (>0.7)	AVE[b] (>0.5)
		Correlation Value	Sig.	Remark	Cronbach's Alpha	Remark		
Perceived Severity (PS)	PS1	0.932	0.000	Valid	0.927	Reliable	0.960	0.890
	PS2	0.937	0.000	Valid				
	PS3	0.935	0.000	Valid				
Perceived Susceptibility (PSC)	PSC1	0.932	0.000	Valid	0.931	Reliable	0.963	0.896
	PSC2	0.936	0.000	Valid				
	PSC3	0.945	0.000	Valid				
Response Efficacy (RE)	SE1	0.931	0.000	Valid	0.933	Reliable	0.964	0.899
	SE2	0.942	0.000	Valid				
	SE3	0.944	0.000	Valid				
Self-Efficacy (SE)	RE1	0.929	0.000	Valid	0.93	Reliable	0.962	0.816
	RE2	0.948	0.000	Valid				
	RE3	0.931	0.000	Valid				
Response Cost (RC)	RC1	0.944	0.000	Valid	0.937	Reliable	0.962	0.894
	RC2	0.935	0.000	Valid				
	RC3	0.949	0.000	Valid				
Perceived Usefulness (PU)	PU1	0.92	0.000	Valid	0.937	Reliable	0.966	0.875
	PU2	0.911	0.000	Valid				
	PU3	0.915	0.000	Valid				
	PU4	0.923	0.000	Valid				
Perceived Ease-of-Use (PEOU)	PUEO1	0.956	0.000	Valid	0.933	Reliable	0.965	0.902
	PUEO2	0.948	0.000	Valid				
	PUEO3	0.913	0.000	Valid				
Subjective Norm (SN)	SN1	0.905	0.000	Valid	0.91	Reliable	0.951	0.865
	SN2	0.936	0.000	Valid				
	SN3	0.922	0.000	Valid				
Behavioral Intention (BI)	BI1	0.946	0.000	Valid	0.872	Reliable	0.928	0.866
	BI2	0.938	0.000	Valid				
Usage Behavior (UB)	UB1	0.928	0.000	Valid	0.854	Reliable	0.918	0.849
	UB2	0.943	0.000	Valid				

Note: [a] CR: Composite Reliability; [b] AVE: Average Variance Extracted

Table 4 Multivariate Analysis Test. The outliers were detected if the Mahalanobis distance > a specified critical distance (χ^2). $\chi^2 = 58.3012$; $p<0.001$; df: the number of indicators = 29.

Observation number	Mahalanobis d-squared
175	43.478
246	42.208
164	41.900
234	41.591
125	41.432
107	41.391
18	41.325
133	41.292
98	41.015
195	40.969
163	40.489
191	40.446
2	40.344
184	40.147
.	.
.	.
.	.
.	.
243	31.875

Table 5 Discriminant Validity Test

	PS	SE	PSC	RE	RC	PU	PEUO	SN	BI	UB
PS	**0.943**									
SE	0.941	**0.948**								
PSC	0.940	0.928	**0.947**							
RE	0.913	0.912	0.921	**0.946**						
RC	0.905	0.914	0.930	0.927	**0.951**					
PU	0.740	0.908	0.751	0.747	0.726	**0.936**				
PEUO	0.721	0.751	0.718	0.722	0.766	0.925	**0.950**			
SN	0.755	0.730	0.769	0.769	0.927	0.911	0.926	**0.930**		
BI	0.914	0.910	0.931	0.930	0.924	0.904	0.883	0.894	**0.931**	
UB	0.928	0.908	0.883	0.873	0.877	0.755	0.758	0.758	0.935	**0.921**

Table 6 Goodness of Fit

Goodness of Fit		Recommended Value for Model Fit	Value
Absolute Fit Indices	CMIN/df	$\chi 2/df<3.0$	2.010
	GFI	≥0.90, >0.5 acceptable	0.529
	AGFI	≥0.90, >0.5 acceptable	0.442
	RMSEA	≤0.08	0.164
Incremental Fit Indices	NFI	≥0.90, >0.5 acceptable	0.708
	CFI	≥0.90, >0.5 acceptable	0.731
	IFI	≥0.90, >0.5 acceptable	0.732
Parsimonious Fit Indices	PNFI	>0.5	0.639
	PGFI	>0.5	0.660

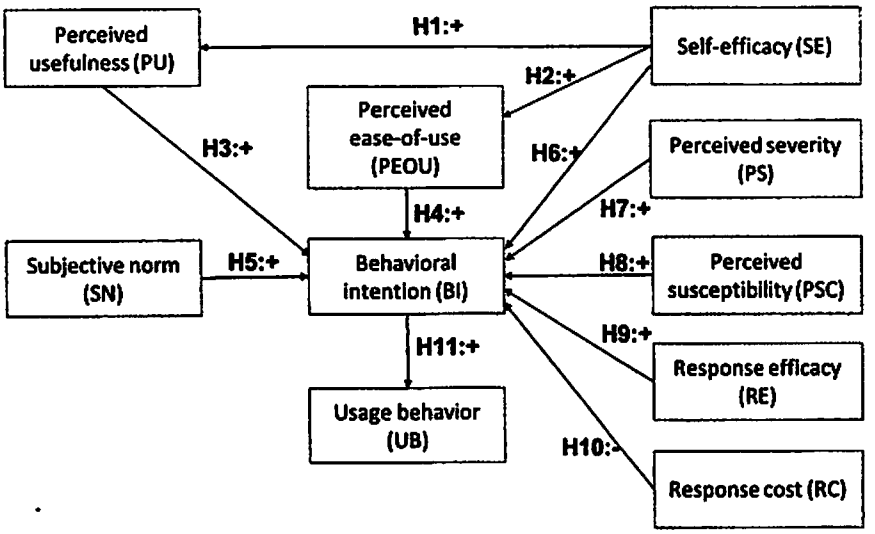

Figure 1 The research model to characterize the consumer behavior in leveraging social media for e-patient and health-related activities

60x36mm (600 x 600 DPI)

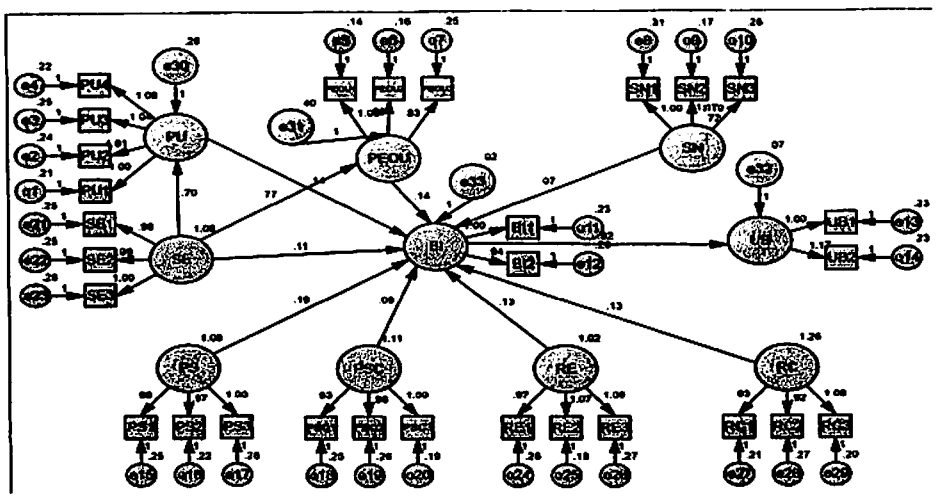

Figure 2 The structural model

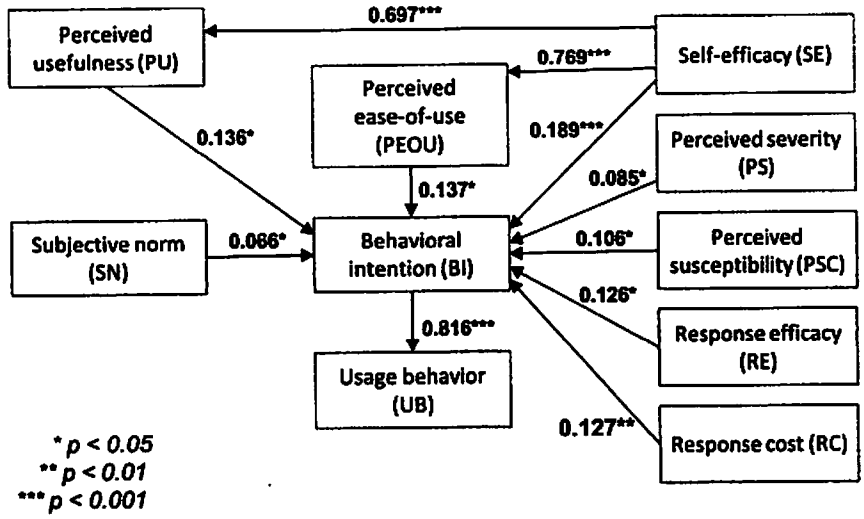

Figure 3 The final proposed model based on covariance-based structural equation modeling. Perceived usefulness, perceived ease of use, perceived severity, response efficacy, and response cost had significant impacts on behavioral intention. Behavioral intention also positively corresponded to usage intention.

60x36mm (600 x 600 DPI)

Appendix A

A.1 The Questionnaire Construction

Table A1 Variable, indicator, and the corresponding question used in the questionnaire.

Variable	Indicator	Question
Perceived Severity (PS)	PS1	I believe that if I was unresponsive to be aware of a serious disease, the prevention and the treatment would be more difficult
	PS2	I believe that serious disease would impact my whole life
	PS3	I would feel distressed to get a serious disease
Perceived Susceptibility (PSC)	PSC1	My chances of getting a serious disease is high
	PSC2	Getting a serious disease is a big concern for me
	PSC3	I feel more vulnerable to a serious disease than others
Response Efficacy (RE)	RE1	Using social media for e-patient and health-related activities would help me detect a serious disease early
	RE2	Engaging in e-patient and health-related activities in social media would help me monitor my health
	RE3	Engaging in e-patient and health-related activities in social media would help me recognize my health condition
Self-Efficacy (SE)	SE1	I believe that I would use social media for e-patient and health-related activities
	SE2	I feel confident that I would be able to operate social media for e-patient and health-related activities
	SE3	I feel confident with my ability to use social media, even without any guidelines on how to use it
Response Cost (RC)	RC1	Using social media for e-patient and health-related activities requires a lot of time
	RC2	Using social media for e-patient and health-related activities would change my lifestyle
	RC3	Using social media for e-patient and health-related activities is inconvenient
Perceived Usefulness (PU)	PU1	Using social media for e-patient and other health-related activities would help me understand health issues that matter to me
	PU2	Using social media for e-patient and health-related activities will would me track health issues that matter to me
	PU3	Using social media for e-patient and health-related activities would assist me obtain feedback and advice from medical professionals and other consumers
	PU4	Overall, using social media for e-patient and health-related activities would improve my healthcare management.
Perceived Ease-of-Use (PEOU)	PEOU1	Using social media for e-patient and health-related activities would be easy for me
	PEOU2	I feel familiar with social media features to access health information

	PEOU3	It would be easy for me to become skillful at using social media for e-patient and health-related activities
Subjective Norm (SN)	SN1	My family and friends use social media for e-patient and health-related activities
	SN2	According to my family and friends, I should use social media for e-patient and health-related activities
	SN3	I use social media for e-patient and health-related activities because my family and my friends also use it
Behavioral Intention (BI)	BI1	I would like to continue to use social media for e-patient and health-related activities
	BI2	My intention to use social media for e-patient and health-related activities is high
Usage Behavior (UB)	UB1	I frequently use social media for e-patient and health-related activities
	UB2	I explore and use many features of social media for e-patient and health-related activities

Note: The indicators were measured using 6-point Likert scale, i.e., strongly disagree (1), disagree (2), somewhat disagree (3), somewhat agree (4), agree (5), and strongly agree (6).

A.2 Questionnaire

Dear participant,

The evolution of social media and the emergence of e-patient movement have encouraged global consumers to use social media for e-patient and health-related activities. This survey aims to examine how you engage in social media for health-related purposes. Your answer will be helpful in improving the quality of online health communication and e-patient via social media. Your responses will be confidential and will be used for research purpose only.

Thank you very much for your participation.

Demographic Profile

Gender	: ☐ Male	☐ Female			
Age	: ☐ 18 – 27	☐ 28 - 37	☐ 38 - 47	☐ 48 - 57	☐ > 57
Occupation	: ☐ Student: high school, undergraduate, graduate				
	☐ Professional				
	☐ Entrepreneur				
	☐ Housewife				
	☐ Other:				
Social media period of use	: ☐ < 1 year	☐ 1 – 3 years	☐ 4 – 6 years	☐ > 6 years	

Social Media Profile

What social media platform(s) do you use for e-patient and health-related activities? Please select all answers that apply.

☐ Facebook ☐ YouTube

☐ Twitter ☐ Web-blog

☐ Instagram ☐ Other: .....

How do you use social media for e-patient and health-related activities? Please select all answers that apply.

☐ Health information search and discussion about specific disease

☐ Health information search and discussion about specific medicine

☐ Health information search and discussion about diet plan

☐ Access to medical professionals and health institution contact

☐ Nutrition plan

☐ Health information search and discussion about pregnancy

☐ Access to health insurance provider

☐ Other: .....

Health Perception and E-patient in Social Media

Please check (√) one answer of each statement which corresponds most closely to your agreement / disagreement based on the following scale:

1: strongly disagree; 2: disagree; 3: somewhat disagree; 4: somewhat agree; 5: agree; 6: strongly agree

Question	1	2	3	4	5	6

Question	1	2	3	4	5	6
Perceived severity						
I believe that if I was unresponsive to be aware of a serious disease, the prevention and the treatment would be more difficult						
I believe that serious disease would impact my whole life						
I would feel distressed to get a serious disease						
Perceived susceptibility						
My chances of getting a serious disease is high						
Getting a serious disease is a big concern for me						
I feel more vulnerable to a serious disease than others						
Response efficacy						
Using social media for e-patient and health-related activities would help me detect a serious disease early						
Engaging in e-patient and health-related activities in social media would help me monitor my health						
Engaging in e-patient and health-related activities in social media would help me recognize my health condition						
Self-efficacy						
I believe that I would use social media for e-patient and health-related activities						
I feel confident that I would be able to operate social media for e-patient and health-related activities						
I feel confident with my ability to use social media, even without any guidelines on how to use it						
Response cost						
Using social media for e-patient and health-related activities requires a lot of time						
Using social media for e-patient and health-related activities would change my lifestyle						
Using social media for e-patient and health-related activities is inconvenient						
Perceived usefulness						
Using social media for e-patient and other health-related activities would help me understand health issues that matter to me						
Using social media for e-patient and health-related activities will would me track health issues that matter to me						
Using social media for e-patient and health-related activities would assist me obtain feedback and advice from medical professionals and other consumers						
Overall, using social media for e-patient and health-related activities would improve my healthcare management.						
Perceived ease of use						
Using social media for e-patient and health-related activities would be easy for me						

Question	1	2	3	4	5	6
I feel familiar with social media features to access health information						
It would be easy for me to become skillful at using social media for e-patient and health-related activities						
Subjective norm						
My family and friends use social media for e-patient and health-related activities						
According to my family and friends, I should use social media for e-patient and health-related activities						
I use social media for e-patient and health-related activities because my family and my friends also use it						
Behavioral intention						
I would like to continue to use social media for e-patient and health-related activities						
My intention to use social media for e-patient and health-related activities is high						
Usage intention						
I frequently use social media for e-patient and health-related activities						
I explore and use many features of social media for e-patient and health-related activities						

LAMPIRAN 2 Luaran Penelitian 2: Jurnal Internasional Bereputasi

Luaran penelitian 2 adalah artikel ilmiah yang di-*submit* ke International Journal of Business Information Systems.

Nama jurnal yang dituju:	**International Journal of Business Information System** **URL: www.inderscience.com/ijbis**
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Judul artikel:	**Making the Information Technology (IT) – Business Alignment Works: A Framework of IT-based Competitive Strategy**
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Bukti *acceptance* artikel

Final Refereeing Decision IJBIS_189468

Inderscience Online <noreply@indersciencemail.com> 29 May 2018 at 16:12
Reply-To: Inderscience Online <noreply@indersciencemail.com>, Submissions Manager <submissions@inderscience.com>
To: ira-p@fst.unair.ac.id, f.jie@ecu.edu.au, Editor <an.gunasekaran@gmail.com>

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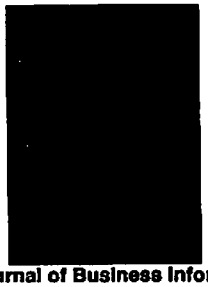

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- **Making the Information Technology (IT) Business Alignment Works: A Framework of IT-based Competitive Strategy**

  by Ira Puspitasari, Ferry Jie

  Abstract: Seamless ITbusiness integration enables superior performance and provides value creation opportunities for an enterprise to achieve a sustainable competitive advantage. Yet, creating IT-business alignment remains a challenge. Some users consider the existing IT-business alignment methodologies too complicated for practical implementation. This paper proposes a simplified and practical framework, an IT-based competitive strategy framework, to align an IT strategy with enterprise businesses based on a design science research methodology. The framework consists of three elements to formulate a comprehensive IT-based strategy, i.e., value drivers of IT implementation, competitive factors, and an IT competitive strategy. The framework evaluation includes interviewing experts and practitioners, applying the proposed framework in an Indonesian enterprise, and assessing the framework benefits on a qualitative basis. The observational evaluation with the experts concludes that the proposed framework is helpful for the targeted users. The framework application in a company also demonstrates the advantage and the usefulness of the proposed framework.

  Keywords: *IT business alignment; IT management; IT-based competitive strategy; IT business alignment framework; competitive strategy; IT strategy.*

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Making the information technology-business alignment works: a framework of IT-based competitive strategy

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Keywords: IT-business alignment; IT-based competitive strategy; IT-business alignment framework; competitive strategy; IT strategy; IT management.

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1 Introduction

Information technology (IT) has become a vital and integral part of a business process in an enterprise. IT serves as an enabler and a support for an enterprise to achieve a sustainable competitive advantage (Powell and Dent-Micallef, 1997; Drnevich and Croson, 2013; De Haes and Van Grembergen, 2016). IT enables a business to perform its core and supporting activities in its value chain either at a lower cost (Drnevich and Croson, 2013), differently (Melville et al., 2004) or at a superior quality (Ye and Wang, 2013; Stadtler, 2015). An intelligent supply management system can facilitate low-cost leadership by directly linking consumer and market behaviour to production, supply chain and distribution (Trkman et al., 2007; Ye and Wang, 2013; Hugos, 2018). An appropriate application of an information system and technology supports innovative ways to do the business (Powell and Dent-Micallef, 1997; Melville et al., 2004; Wang et al., 2015), e.g., strengthening customer relationship, encouraging product/service innovation and creating highly potential opportunities. These capabilities are the sources of competitive advantages for an enterprise to create unique sets of skills, assets and strategies that enable superior performance compares to other enterprises in the same field (Melville et al., 2004; Drnevich and Croson, 2013; Stadtler, 2015; Wang et al., 2015).

Creating competitive advantage requires aligning an IT implementation strategy with business needs (Bhatt and Grover, 2005; Cui et al., 2015; Wang et al., 2015). A set of framework and methodologies has been proposed to align an IT implementation strategy with an enterprise business vision. Some of the methodologies are enterprise architecture (EA) (Lankhorst, 2013; Simon et al., 2014), IT governance (Cater-Steel, 2008; Tallon et al., 2013; Wu et al., 2015) and IT-business alignment methodologies (Chan and Reich, 2007; Luftman et al., 2017). Whilst these alignment methodologies include theoretical background, complete guidance and practical step-by-step activities, applying those effectively in an enterprise work is an uphill struggle (Bernaert et al., 2016). For example, most of EA stakeholders consider EA content too complicated to be implemented in daily enterprise work (Kruchten, 1999; Puspitasari, 2016). An EA model is usually large and over-engineered, thus making it more difficult to implement (Bernaert et al., 2016). Another case is the application of COBIT (formerly: control objective for information and related technology) 5 to implement enterprise governance of IT (EGIT). COBIT 5 is a comprehensive framework whose implementation in an enterprise involves a large number of objects, processes and relations, resulting in highly complex models (Bartens et al., 2015).

Strategic alignment between IT infrastructure and business needs is essential in any enterprises, regardless of its type, size and situation. New enterprises and small medium enterprise (SMEs) do not usually have adequate skills and resources to implement the existing methodologies. They also encounter difficulties in employing experts and consultants. Therefore, these enterprises need practical and less complex methodologies

to initiate IT-business alignment effort and to formulate proper IT strategy. For enterprises that experience IT chaos, they also need a practical and quick solution to assist with the reorganisation of their IT management.

To alleviate some of the problems in managing IT in an enterprise, this paper proposes a framework of IT-based competitive strategy. The framework contains practical and simplified guidance to align an IT strategy with enterprise businesses toward creating and sustaining the competitive advantages. At the initial phase of IT management, especially in SMEs, this framework serves as a shortcut tool in formulating an IT strategy. The framework facilitates a rapid development of an IT strategy using simplified procedures and less complicated models. For enterprises whose IT management is in a turmoil phase, the proposed framework can be used as a tool to re-identify the value driver of their IT implementation and to revise their IT strategy. The outcome of the framework application can be mapped and developed further using other methodologies in accordance with the enterprise's needs.

2 Research design

This paper adopted *design science research* methodology (Gregor and Hevner, 2013). *Design science research* in information system research focuses on the producing of the IT/IS artefact and evaluating its relevance on the application domain (Hevner et al., 2004). The design science paradigm encompasses three design science cycles in each research project, i.e., relevance cycle, design cycle and rigor cycle. The relevance cycle identifies the requirements for research, defines the problem and opportunities statement from the environment and returns the research output to the environment for study and evaluation purposes. The design cycle consists of core activities of building and evaluating artefacts. The artefacts in design science research include constructs, models, frameworks and instantiations (Hevner et al., 2004). The rigor cycle provides a foundation from knowledge-base that underlies the research project.

Figure 1 exhibits the presence of relevance, design and rigor cycles in this research. The relevance cycle provides a problem statement based on the observation in the contextual environment (i.e., enterprises) and a means to implement artefacts in the application domain. The design cycle consists of the following activities:

1 Drawing on the environmental observation and the literature study synthesis, this paper examines the key elements of a practical and comprehensive strategy formulation. It aims to study the phenomenon, challenges and discrepancies between the expected and the actual outcome in IT management practice and to discover enterprises' actual needs. The observation outcome is used to formulate a research problem and to identify the element of the proposed solution. The research problem in this study addresses the difficulty and complexity in managing IT-business alignment, specifically in SME, enterprise whose IT management is at the initial phase and enterprise whose IT management is in turmoil. The proposed solution provides a practical and simplified guidance to alleviate the existing complexity problem, i.e., IT-based competitive strategy framework.

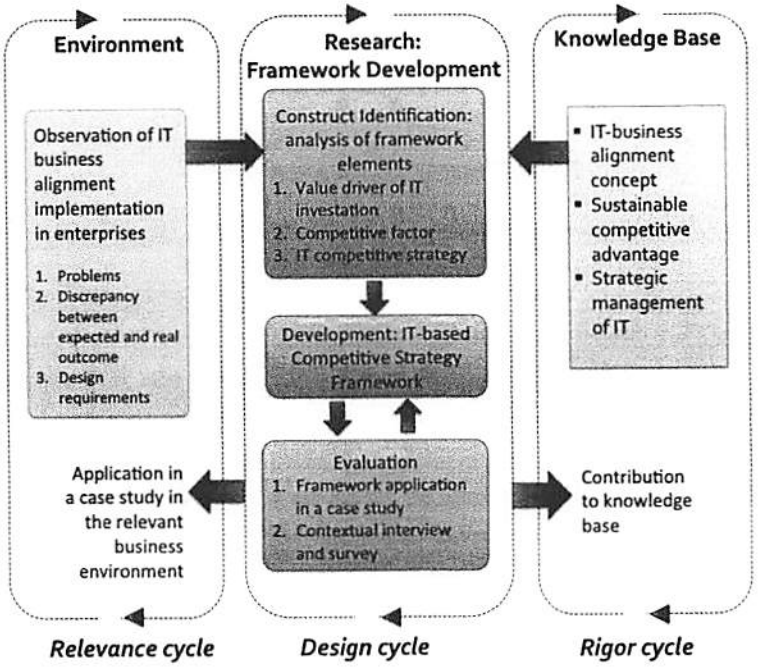
2 Analysis of the framework elements, which provides the construct to build the framework. The construct is derived from the phenomena (people, system, technology, process) observation and exploration (Hevner et al., 2004).

3 Development of IT-based competitive strategy framework, which consists of the formulation of a competitive strategy using IT and the application of the IT-based competitive strategy framework.

4 Evaluation of the framework. The evaluation method is an observational case study at an internet service provider (ISP) company in Indonesia. This evaluation includes the use of the framework to formulate a competitive strategy in the case study and the analysis of feedback results from contextual interviews and surveys.

The rigor cycle provides knowledge-base from prior research projects and best practises in the field of IT-business alignment methodology and IT strategic management. The result of this study also contributes to the development of related knowledge-base. The artefacts of this study consist of a construct (the element of the framework) and a model (IT-based competitive strategy framework).

Figure 1 Research methodology (see online version for colours)



3 Managing IT in business: from IT governance to EA

Aligning an IT strategy with business needs has been a top managerial issue since the implementation and integration of IT in business (Reich and Benbasat, 2000; Luftman et al., 2017). Despite the pervasive role of IT in business, IT value delivery in an enterprise remains a concern. To enhance the capability of IT to meet business requirements, a number of frameworks, best practises and tools have been developed. These includes IT governance framework such as COBIT 5 (De Haes et al., 2013); IT infrastructure library (Cannon, 2011) and EA framework such as Zachman (1999) framework and The Open Group (2009) architecture framework.

IT governance concerns with the achievement of strategic alignment between the objectives of an enterprise and the utilisation of IT in order to achieve these objectives more effectively (Ernest et al., 2004; Buchwald et al., 2014). One of the most widely implemented IT governance tools is COBIT. As a comprehensive framework, COBIT involves a large number of objects, processes and models. Its implementation is perceived as highly complex (De Haes et al., 2013; Bartens et al., 2015); it requires time and efforts to understand COBIT as a framework before it could be practically implemented in an enterprise (Simonsson et al., 2007). The next challenging issue is related to how to start COBIT implementation (Zhang and Le Fever, 2013; Bartens et al., 2015), e.g., which processes are crucial in the starting point, how to develop IT policies and procedures based on COBIT.

Another global standard of best practises in IT service management is information technology infrastructure library (ITIL). In previous studies, researchers concluded two major reasons of ITIL implementation in enterprises, namely to strengthen the customer service and to obtain effective and transparent IT governance (Cater-Steel and Tan, 2005; Pollard and Cater-Steel, 2009). Whilst ITIL provides holistic guidance of IT service management, applying the framework effectively in an enterprise is challenging. ITIL provides general guidance on what process to implement in an enterprise without detailed explanation of how to implement the process (Shang and Lin, 2010). Thus, it commonly requires experts or consultants to assist ITIL implementation in an enterprise. Another issue is quantifying the benefit of ITIL implementation (Cater-Steel and Tan, 2005; Shang and Lin, 2010) due to the nature of the framework.

Managing IT service and infrastructure requires an integrated view of the enterprise organisational system. EA provides an integrated enterprise blueprint in the form of principles, methods and models to design organisational structure, business process, information system and IT infrastructure (Lankhorst, 2013). While the benefit of EA has widely recognised, its application is generally complicated and potentially problematic. The development of EA requires a lot of effort and resources (Morganwalp and Sage, 2004), while the benefits are perceived not directly measurable (Schmidt and Buxmann, 2011).

Strategic alignment between IT strategy and business need is the essential prerequisite to improve the enterprise's performance (Reich and Benbasat, 2000; Luftman et al., 2017), to optimise the return on investment (Abareshi, 2011), to increase the enterprise's business value (Mitropoulos, 2012; Luftman et al., 2017) and to achieve sustainable competitive advantage (Gerow et al., 2014; Miller et al., 2014). However, most methodologies and frameworks of IT-business alignment are complex and not suitable in some situations, such as for an enterprise in the initial phase of managing its

IT, for SMEs and for an enterprise whose IT management is in a turmoil state. New enterprises and SMEs do not usually have adequate skills and resources to implement the existing methodologies. Most SMEs also do not have a dedicated IT department and tend to perceive the benefits of IT in short-term. Therefore, these enterprises need practical and less complex methodologies to initiate IT-business alignment effort and to formulate proper IT strategy. For enterprises that experience IT chaos, they also need a practical and quick solution to assist with the reorganisation of their IT management.

4 IT-based competitive strategy framework

An enterprise operates and interacts with other external entities in a competitive environment. An enterprise strategy defines its performance in its environment. Since the competitive environment has moved to a digital economy (Turban et al., 2007), running an enterprise now relies on an IT-related system and management. Thus, formulating an IT-based enterprise strategy is essential in today's economy. Formulating the strategy requires in-depth understanding of an enterprise vision to assure a strategic IT-business alignment since the beginning of the IT management initiative. IT should be governed by focusing on information that supports a business vision (Bartens et al., 2015).

Table 1 Justification for each framework element

Elements	*Justification*
Value driver of IT implementation	• Analysing the value driver(s) is an essential element of IT governance (Peterson, 2004).
	• One of the key steps in the initial stage of EA development (The Open Group, 2009). The value driver(s) of IT implementation refer to any factor that boosts the total value created by proposing an IT-based solution.
	• The value drivers of IT determine the IT level position in an enterprise (Nath and Standing, 2010).
Competitive factor	• Bowman (2003) and Lucas (2005) stated in their studies, competitive factors increase the efficiency of an enterprise's competitive strategy.
	• Identifying competitive factors is required to formulate an enterprise's competitive strategy.
	• The competitive factor and IT capabilities establish the competitive actions. The competitive actions are the prerequisite towards superior business performance (Chae and Prybutok, 2015).
IT-based competitive strategy	• IT strategy does not only reflect the business vision, but also enables a value creation and enhances enterprise capabilities.
	• A study of selective implementation of COBIT 5 revealed that the manage strategy process (APO 02) was the most important process in COBIT 5 according to nine COBIT experts (Bartens et al., 2015).
	• Strategy formulation is one of the key constituents of strategic dimensions in EA (Simon et al., 2014).

This study proposes a framework to formulate an IT-based strategy. The framework focuses on the practical approach and contains only essential elements to enable a strategy formulation in a time-efficient manner. Drawing on the knowledge-based

synthesis and the environmental observation, the requirements for the proposed framework are:

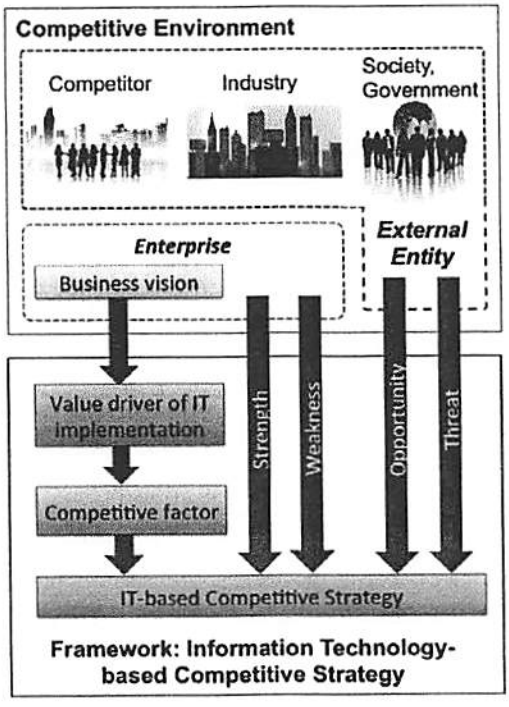
1 Holistic view: the framework provides guidance based on the enterprise-wide perspective to ensure the alignment of all elements in the enterprise. The solution works for the enterprise as a whole rather than within individual department.

2 Simplicity: the framework focuses on the practical approach and contains only the essential elements to translate the enterprise vision into daily management and operation, which is driven by IT.

3 Suitability: the framework is designed to suit the target audiences and to minimise the needs of expert assistance. It can be understood and utilised by people from a different domain, even by those with a limited IT background.

Based on the requirements, the framework consists of three elements to formulate a comprehensive IT-based strategy, i.e., value driver of IT implementation, a competitive factor and an IT competitive strategy. The rationale for each framework element is presented in Table 1. The relationship among these elements constructs the IT-based competitive strategy framework as shown in Figure 2.

Figure 2 The framework development (see online version for colours)



4.1 Value driver of IT implementations

Analysing value driver(s) is an essential element of IT governance (Peterson, 2004) and one of the key steps in the initial stage of EA development (The Open Group, 2009). According to TOGAF, enterprises at their initial maturity levels could use an architectural vision as a starting point. The architectural vision determines the high-level enterprise vision, business goals and strategic value drivers. The value drivers of IT implementation refer to any factors that boost the total value created by proposing an IT-based solution. They come in many forms such as solution integration, cutting edge technology, a cost-efficient business process, an innovation in how to do business and the business outcome, a global collaboration and networking and customer satisfaction. Analysing the right value driver promotes the creation of competitive advantages by aiming at the IT target and development.

The value drivers of IT are derived from enterprise's business visions. The executive and IT manager decide which specific value dimensions to be developed while maintaining other dimensions on an acceptable standard. For example, it is difficult to develop cutting-edge technology and the values of cost-efficient business process simultaneously. Instead, an enterprise can achieve technology leadership in the market while maintaining the cost within a reasonable budget. Based on the IT value model (Ernest et al., 2004) and IT drivers in supply chain (Nath and Standing, 2010), the value drivers determine an IT-level position in an enterprise, i.e., utility, partner and enabler. The utility position provides a standard delivery with lower costs than what a competitor can offer. Reducing costs is the first value driver that should be adopted by new enterprises or SMEs in the initial stage of IT investments. The next position, partner, requires a more complex IT infrastructure to support a collaboration and networking between business units and stakeholders. IT as a partner facilitates business process integration within an enterprise and enhances networking with external stakeholders. IT at the highest-level position enables an enterprise transformation. The drivers in this level are market expansion, business innovation and better customer satisfaction.

4.2 Competitive factors

Recognising the environment is the first step toward achieving competitive advantage (Pitkethly, 2003; Porter, 2011). In digital economy, where most of enterprises operate nowadays, IT is the prerequisite to establish an enterprise's competitive factor. A competitive factor refers to key factors of enterprise advantage that determines enterprise performance and position in its competitive environment (Bowman, 2003; Lucas, 2005). Unique competitive positions in the environment can only be gained and expanded if the enterprise could identify the correct competitive factors to the support business vision and to develop the competitive strategy. As Bowman (2003) and Lucas (2005) stated in their studies, a competitive factor increases the efficiency of an enterprise's competitive strategy. In another study, Chae and Prybutok (2015) stated that the competitive factor and IT capabilities develop the enterprise's competitive actions, a key requirement to achieve superior business performance.

We included a competitive factor as one of the elements in the proposed framework. It extends the strategy formulation, not only to manage the IT department more efficiently, but also to develop unique capabilities as the source of enterprises' competitive advantage. This unique capability specifies the fundamental basis for

strategic choice and the creation of competitive advantage (Simon et al., 2014). Competitive factors depend on the environment where enterprises operate, the characteristics of the industry and the executive perceptions. Enterprise executives and IT managers collaborate to identify competitive factors based on the business vision and the IT implementation value drivers. Some examples of competitive factors are business factors, e.g., business innovative management, the capability to create a new service, a niche market, logistics capabilities, quality service and the capability to create new marketing effort; customer factors, e.g., customer service, personalised service, social media marketing and digital branding; technological factors, e.g., technology infrastructure, distributed networking and interconnected communication.

4.3 IT-based competitive strategy

The importance of IT in today's business is reflected by how it influences and shapes business strategies (Drnevich and Croson, 2013). An IT strategy does not only reflect a business vision, but also enables a value creation and enhances enterprise capabilities. Formulating and managing an IT strategy is one of the essential processes in the governance and management of IT. A study of selective implementation of COBIT 5 revealed that the manage strategy process (APO 02) was the most important process in COBIT 5 according to nine COBIT experts (Bartens et al., 2015).

Formulating an IT-based strategy includes the analysis and identification of capabilities and resources that enterprises can use to gain a competitive advantage over the average industries (Melville et al., 2004; Hsieh and Chen, 2011; Porter, 2011). Despite the importance of IT in shaping the business strategy, IT strategy does not only rely on building an IT infrastructure and service or following the latest technology development, but also involves the use of IT to build up the enterprise's competitive factors. For example, IT can improve customer satisfaction factor by providing helpful customer services and a personalised customer support.

The formulation of an IT strategy requires the articulation of an enterprise's internal domain and the environment's external domain (Henderson and Venkatraman, 1999). A practical and quick way to initiate an IT-strategy formulation is analysing an enterprise's internal strength and weaknesses and identifying the external's opportunities and threats (Simon et al., 2014). The analysis result may range from a list of key points to in-depth elaboration. The next step is mapping each competitive factor to one or more SWOT analysis results. Each competitive factor may correspond to more than one SWOT component. A competitive factor may serve as an enterprise's strength as well as an industrial opportunity. Meanwhile, another competitive factor can be both a current enterprise's flaw and also a growth opportunity. For example, customer support is one of the competitive factors identified in a service company. In the current situation, stakeholders perceive the customer service performance as below expectation based on the customers' reviews and the average time required to deal with customers' request. In the environment where a service company operates, customer support is a decisive opportunity to create a value above the average performance of its competitors.

5 Evaluations

In a design science research, before utilising the artefacts in a field study, all proposed artefacts must be thoroughly evaluated using many potential techniques, such as analytics, case study, simulation and experiment (Hevner et al., 2004; Gregor and Hevner, 2013). In this study, we conducted an observational approach evaluation, which consists of interviewing practitioners and conducting a case study.

5.1 Interview with IT practitioners

The first evaluation, the interviews, was aimed to obtain feedback from experienced professionals and targeted users and to assess the benefit of the proposed framework. We interviewed eight IT practitioners from various enterprises, i.e., two IT industry consultants from a national state company, three academic researchers specialising in IT governance, two production managers responsible for IT infrastructure and service for SMEs and an IT consultant from a consulting firm. We inquired participants' opinion and assessment about three key aspects of the framework evaluation as in Table 2. All interview sessions were audio recorded.

Table 2 Coverage for interview and survey questions

Key evaluation	*Interview question*	*Assessment survey*
The suitability of each construct in the framework.	Is each element in the framework required for the strategy formulation? Does each element contribute to the expected outcome of the framework?	The suitability of each construct in the framework. (1 = very unsuitable, 5 = very suitable)
The comprehensiveness of the proposed framework to meet its requirements and objectives.	Does the proposed framework meet the requirements, i.e., delivering holistic view, ensuring suitability and providing simplicity? Does the proposed framework comprise adequate elements to aid IT-based competitive strategy formulation?	The comprehensiveness of the proposed framework to meet its requirements and objectives. (1 = very incomprehensive, 5 = very comprehensive)
The usefulness of the proposed framework for the targeted users.	Does the proposed framework really help in IT-based competitive strategy formulation? Does the proposed framework reduce/solve the complexity issue in other methodologies or framework? How does it complement other methodologies or framework? Does the proposed framework provide ease of use? Do you think the proposed framework can be understood and utilized by people with a limited background in IT?	• The easiness of understanding and using the existing frameworks and methodologies. (1 = very difficult, 5 = very easy) • The easiness of understanding and using the proposed framework. (1 = very difficult, 5 = very easy) • The usefulness of the proposed framework for the targeted users. (1 = very useless, 5 = very helpful)
General feedback	Please explain your overall impression and general feedback of the proposed framework.	—

5.2 Results of the interview

The result of the assessment survey is presented in Table 3. On average, the participants assessed the suitability of each element in the framework as 3.13 (on a scale 1 to 5). The participant from the consulting firm questioned the relation between the value driver of IT implementation and the competitive factor. Participants from SMEs suggested examples of the framework application in case studies. The participants from a national state company acknowledged that the proposed constructs could help the initial strategy formulation. However, the constructs were not adequate to build a comprehensive strategy.

Table 3 Result of assessment survey by experts and practitioners in evaluation 1

Question	*Mean*	*Std. dev.*
The suitability of each construct in the framework.	3.13	0.64
(1 = very unsuitable, 5 = very suitable)		
The comprehensiveness of the proposed framework to meet its requirements and objectives.	3.25	0.89
(1 = very incomprehensive, 5 = very comprehensive)		
The easiness of the understanding and using the existing frameworks and methodologies.	2.25	0.89
(1 = very difficult, 5 = very easy)		
The easiness of the understanding and using the ITCS framework.	3.75	0.71
(1 = very difficult, 5 = very easy)		
The usefulness of the proposed framework for the targeted users.	3.38	0.74
(1 = very useless, 5 = very helpful)		

In the case of the comprehensiveness of the framework, the participants gave 3.25 on average (on a scale of 1 to 5). The participant from a consulting firm considered the proposed framework loose in methodology and lacking in detailed procedures, thus the holistic aspect of the framework was questionable. On the contrary, participants from SMEs argued that the proposed framework was sufficiently comprehensive to develop an IT strategy. Academic researchers and IT consultants from national state companies also recognised that the proposed framework captured the essential requirement to transform an enterprise vision to a practical IT-based strategy. However, they argued that the proposed framework was more relevant for the initiation tool in the IT-business alignment effort.

The proposed framework aims to reduce the complexity issue that mostly occurs when adopting methodologies and frameworks to achieve IT-business alignment. In general, most participants found the proposed framework more understandable than the existing methodologies. However, a participant believed that the proposed framework was just as difficult as the existing methodologies. The existing methodologies (e.g., ITIL, ITSM, COBIT and TOGAF) were difficult because of the complexity in the scope, process definition, library and data management. On the other hand, the proposed framework was also considered difficult because it was too simple, hence confusing; there was no detail explanation on the framework methodology and the relation among the framework elements.

All in all, most participants acknowledged that the proposed framework was helpful for the targeted users, i.e., the small-medium enterprise whose resources are limited, the enterprise whose IT management is at its initial phase or has been running ineffectively for an extended period of time. Additionally, seven out of eight participants suggested applying the framework in the targeted user environment to evaluate the framework more thoroughly. Most participants also acknowledged that the framework was excellent in terms of its easiness and practicality compared to other existing methodologies. Participants from national state companies and the consulting firm suggested that the application of IT-based competitive strategy framework should be combined with more developed methodologies or frameworks.

6 The application of IT-based competitive strategy framework in a case study

The second part of the evaluation was using the framework to formulate an IT-based competitive strategy in an ISP in Indonesia. This paper used a pseudonym name MMI Inc. with respect to the consent given by the company for the sake of privacy and security.

6.1 Profile of MMI Inc.

MMI Inc. is one of the ISP pioneers in Indonesia. The company provides high speed internet, TV cable, VPN, mobile data and dial up internet. The prepaid mobile data (PMD) service was released in 2008. It was a breakthrough in the internet access service at that time. The service introduced a flexible payment and affordable rates for personal market. This new service boosted the customer growth to 400% by the end of the first semester in 2012.

Unfortunately, the vigorous marketing effort was not followed by technology development. The number of customers multiplied, but the infrastructure capacity remained stationary. The fast connection only occurred in the first few months of subscription. Afterward, the speed connection dropped and the service became more inaccessible. The high network load also caused disruptions to other company's internet services that shared the same infrastructure with PMD. This problem briefly damaged the MMI's reputation including the corporate cable service, the company's highlight on internet service and its reputation as one of the market leaders. This situation shows that unsynchronised strategy between business marketing and IT management led to company's loss.

6.2 Value drivers of IT implementation and competitive factors

MMI's core business is providing services to access and to use the internet that is part of and heavily depends on the IT infrastructure and services. In order to support the core business, IT optimises the business process operation, enhances the company's performance and provides a significant competitive factor in the industry. Thus, the value drivers of IT implementation at MMI Inc. are as follows:

1 Progressive expansion of IT infrastructure and services

IT service availability and IT infrastructure reliability are essential in MMI business. Investing in cutting-edge technology is necessary to stay in front line in business competition. However, this investment requires enormous costs and comes with high risks. IT implementation at MMI Inc. addresses optimisation of the expansion strategy, progressive infrastructure development with a reasonable budget that yields optimum return.

2 Integration of business processes

Correctly applied technology brings advantages to business processes, such as superior performance, cost-effective operation and integration processes across multiple divisions/organisations. Business process integration plays a key role in terms of its adaptive capability in the digital environment, where MMI Inc. operates.

3 Customer satisfaction

Keeping customers satisfied is crucial, especially in a competitive ISP industry.

Competing in digital environment requires agility and flexibility to stay ahead of the competition. As in the case of MMI Inc., change occurs frequently in its digital environment, especially in technology advancement and internet service business. The competitive factors of MMI Inc. are defined as follows:

1 Business innovation management (CF1)

Business innovation management refers to administering innovation processes for both the outcome and the business processes (service creation and delivery). Innovation is encouraged at every level of the company. The innovation management provides agility and flexibility for the company by performing continuous development internally, integrating business processes among internal divisions and between the company and external stakeholders and developing improved solutions to meet customers' needs.

2 Customer support (CF2)

Building a good reputation via customer support excellence is a valuable competitive factor. A growing number of cellular network operators had entered the ISP market in Indonesia since 2008. These companies operate with well-equipped supports, such as established mobile infrastructure, aggressive promotional effort and prominent branding. This situation has created a competitive market. Customers can shift to other providers whenever they feel dissatisfied or want to get more suitable service (e.g., higher access speed, larger bandwidth, more responsive customer support and cheaper cost).

3 Technology infrastructure (CF3)

Technology advancement in ISP industry is a challenge for the company. A conscientious plan and execution is necessary to keep up with technology advancement. If the company does not move at the same level as the advancement, its progress is hindered and this causes loss. On the other hand, hastily following the latest advancement is expensive and ineffective.

6.3 IT-based competitive strategy in MMI Inc.

The formulation of IT-based competitive strategy for MMI Inc. adheres to the following procedure.

1 Analysing the current strength, weaknesses, opportunities and threats of MMI Inc.

Example of MMI Inc.'s SWOT analysis result is presented in Table 4.

2 Formulating an IT-based competitive strategy by mapping each competitive factor in SWOT elements.

Example of IT-based strategy based on SWOT analysis is presented in Table 5.

Table 4 Example of SWOT analysis

Strength (S)		*Weakness (W)*	
S1	Good reputation in corporate/business internet access. MMI Inc. has established partnerships with office buildings and shopping centres.	W1	Limited infrastructure and coverage areas outside major cities.
S2	High-speed data infrastructure in major cities in Indonesia, e.g., fibre optic cables and copper wires, public WIFI-hotspot.	W2	Declining customers' trust in prepaid mobile data service.
S3	A number various internet access services, such as corporate dedicated internet access, broadband services and personal cable internet.	W3	Mediocre customer support based on customer reviews.
Opportunity (O)		*Threat (T)*	
O1	An increase in internet access demand and the potential growth of internet users at a significant rate.	T1	Internet access services provided by cellular network operators, e.g., mobile data plan, prepaid mobile data and unlimited data plan. These services are supported by more established infrastructure, wider coverage and cheaper price.
O2	Corporate demands of the fast and superior internet access services.	T2	Government regulation and legal matters pertaining to infrastructure lease and spectrum utilisation policy of frequency band.

6.4 Case study evaluations

We conducted contextual in-depth interviews and surveys to assess the framework application in MMI Inc. The participants of the in-depth interviews and surveys were six representatives of MMI Inc., i.e., a manager of business development division, a manager of technology and infrastructure division, two assistant managers of business development division and two assistant managers of technology and infrastructure division. The interviews and surveys aimed to obtain feedback from the experienced professionals and to assess the benefits of the proposed framework. The evaluation was conducted in the following steps:

1 Pre-evaluation, the participants examined the strategy formulation report provided by the authors. The report described the application of the proposed framework to formulate MMI Inc.'s competitive strategy and its results.

2 Assessment questionnaire, the questionnaire assessed the following criteria:
   a The easiness of understanding the framework.
   b The easiness of using the framework. This criterion assessed the degree of easiness of using the framework to formulate competitive strategy considering the company's situation.
   c The suitability of the framework with the company's needs, this criterion assessed the framework fitness for the company's profile, needs and situation.
   d The usefulness of the result obtained from applying the framework, this criterion assessed the usefulness of the result (an IT-based competitive strategy) for the company's needs.
   e The confidence level of the result quality, this criterion assessed how confident the participant was with the result quality obtained from applying the framework.

3 In-depth interviews with each participant. The interview questions included the role and responsibility of each participant in MMI Inc., the roles of IT in business, the degree of integration between IT and business, the usefulness of the IT-based competitive strategy framework in helping to formulate a good strategy, the willingness to use the framework and feedback about the framework. All interview sessions were audio recorded.

6.5 Results of case study evaluations

The results of the assessment questionnaire are presented in Table 6. The results showed that none of the participants found it difficult to learn and use the IT-based competitive strategy framework. In the interviews, four participants mentioned the framework simplicity as an advantage. On the contrary, a participant from business development division argued that the simplicity was inadequate for an IT-based framework. Indeed, the participant suggested that the framework should include a strategy evaluation and a more detailed procedure to translate the value drivers of the IT implementation in order to foster business competitive factors.

In the case of the framework suitability with the company's profile, needs and situation, 66.67% participants rated it as moderately suitable and highly suitable. Three participants acknowledged the sequence of competitive factors, the SWOT analysis and the IT-based competitive strategy as a clear-cut solution in the IT-business alignment effort. These solutions could be developed further according to the company's needs.

As a tool to help formulate an IT-based competitive strategy faster, participants rated the framework as somewhat useful (50%), moderately useful (33.33%) and highly useful (16.67%). Regarding the results, most participants were somewhat confident (33%) and moderately confident (33%) that the framework results were qualified, i.e., applicable and reasonable.

Table 5 Example of IT-based competitive strategy for MMI Inc.

Competitive factor		*IT-based competitive strategy*	
Strength (S)			
CF1	Business innovation management	S1.CF1.1	Expanding corporate partnerships to strengthen the corporate data service brand.
		S3.CF1.2	Providing a customised internet access service based on customer's needs. For example, offering larger bandwidth and higher speed or adding optional value-added service.
CF3	Technology infrastructure	S2.CF3.1	Analysing the customer growth and strengthening the infrastructure at the busiest locations (sites with top customer growth).
		S2.CF3.2	Installing new public WIFI hotspots in strategic locations.
Weakness (W)			
CF2	Customer support	W2.CF2.1	Strengthening the customer service via social media to improve the reputation and to rebrand the PMD service.
		W3.CF2.1	Improving the customer support management: emphasising responsive and accurate customer solution, offering appropriate compensation to affected customers.
		W2/W3.CF2.2	Building a customer support system that is integrated with infrastructure and service division and sales and marketing division.
		W2.CF2.3	Revising the promotional and sales program of PMD service or temporarily terminating PMD's customer growth until attaining an acceptable ratio between the number of customers and the service quality.
CF3	Technology infrastructure	W1.CF3.1	Creating the infrastructure and service development plan in potential areas, such as special economy zone and tourist destinations outside Java and Bali.
			Investing and building infrastructure progressively based on the development plan.
		W1.CF3.2	Collaborating with other providers to provide larger bandwidth capacity and to expand the market by renting infrastructure and sharing resources.
		W2.CF3.1	Increasing bandwidth capacity for PMD service until attaining an acceptable ratio between the number of customers and the bandwidth provided.
Opportunity (O)			
CF1	Business innovation management	O1.CF1.1	Utilising social media to advertise internet services in accordance with each market segment.
		O1.CF1.2	Introducing an economic corporate internet plan for educational institutions and small medium enterprises.
		O1.CF1.3	Promoting a bundling service (internet access and network device) for personal customers.
		O2.CF2.1	Introducing MMI Inc.'s corporate internet service to the new market via partnership with regional government.
CF2	Customer support	O1.CF2.1	Providing a personalised customer support for personal customers.
		O2.CF2.1	Providing a dedicated customer support for corporate customers.
Threat (T)			
CF1	Business innovation management	T1.CF1.1	Establishing a joint venture with a cellular network operator to supply reliable mobile internet access outside major cities in Indonesia and in rural areas.
		T2.CF1.1	Performing a regular audit and ensuring that all business activities comply with the government and ISP industry regulations.

Table 6 Questionnaire result in evaluation 2 (case study)

Assessment	*Result*					
Easiness level of understanding the framework	Very difficult	Difficult	Average	Easy	Very easy	Σ
	0%	0%	33.33%	50%	16.67%	100%
Easiness level of using the framework	Very difficult	Difficult	Average	Easy	Very easy	Σ
	0%	0%	50%	50%	0%	100%
Suitability of the framework	Not suitable	Slightly suitable	Somewhat suitable	Moderately suitable	Highly suitable	Σ
	0%	16.67%	16.67%	50%	16.67%	100%
Degree of usefulness	Not useful	Slightly useful	Somewhat useful	Moderately useful	Very useful	Σ
	0%	0%	50%	33.33%	16.67%	100%
Confidence level of the result quality	Not confident	Slightly confident	Somewhat confident	Confident	Highly confident	Σ
	0%	16.67%	33.33%	33.33%	16.67%	100%

All participants also agreed that IT is one of the key competitive factors in the company's industry. Hence, the IT strategy must be aligned with the business strategy. However, aligning IT with business was not always easy at MMI Inc. The IT-related division had used several approaches and tools of IT management frameworks with less success. Some of the approaches were too complicated and other tools lacked business perspective presence. On the other hand, business-related divisions sometimes had different perspectives about the IT-business alignment.

All participants were aware of the consequences of loose linkage between IT and business. One of the most significant examples was the PMD service when the aggressive marketing effort was not followed by the infrastructure development. It took years to fix the damage, including restoring the reputation. The alignment remains a challenge in MMI Inc. The executives and managers from IT-related and business-related divisions continue to develop the best methods to achieve better-aligned management in the future.

All participants agreed that the proposed framework was useful as a quick help to formulate an IT-based strategy to gain business advantages. Participants from the technology and infrastructure division acknowledged the simplicity of the framework and its potential benefits. All participants were also willing to use the framework as the first step to achieve better IT-business alignment.

7 Discussions and feedbacks to the proposed framework

7.1 Making the IT-business alignment works using a practical and simplified approach

For more than 30 years, IT practitioners and academics have identified IT-business alignment as one of the most pervasive problems in IT management practice. Prior studies have proposed numerous methodologies, frameworks and best practices, yet the

alignment concept remains obscure. Some of the methodologies view IT-business alignment as a static relationship, thus lacking practical guidance on how to improve the alignment sustainability (Luftman et al., 2017). Most methodologies and frameworks of IT-business alignment are also complex and not suitable in some situations. Hence, this study proposes a simplified and practical framework to alleviate some of the problems in IT-business alignment, i.e., IT-based competitive strategy framework. The framework serves as straightforward guidance and first aid in IT-based strategy formulation. The framework simplicity aims to solve the difficulty and complication in actualising IT management conceptual models into practical application. The IT-business alignment is demonstrated by analysing the value drivers of IT implementation based on the enterprise's visions, by identifying business competitive factors and by developing an IT-based strategy to optimise the competitive factors.

The results of the interview evaluation and the case study evaluation support the simplicity of the framework. Based on the practitioners' judgement, the simplicity is the main advantage of the proposed framework and it creates a user-friendly methodology. They also acknowledge that simplicity provides benefits in terms of reducing the difficulty of applying the IT management framework in an enterprise. However, a participant from the first evaluation raises a concern that the simplicity is inadequate for an IT-based framework because it may lead to confusion in the framework application. We acknowledge the concern, but we retain the simplicity requirement to facilitate the framework application in the targeted user's environment and to minimise the need of experts' assistance.

IT adoption in SMEs is still lagged behind due to several factors (Chong et al., 2012; Steinfield et al., 2012; Dahnil et al., 2014), e.g., lack of resources and expertise, limited IT literacy and lack of awareness of IT advantages for SMEs, expensive initial cost and the perceived complexity of IT adoption. The proposed framework could help SMEs resolve IT adoption barriers. The simplicity of the framework offers straightforward procedures to identify IT requirements that best serve the ongoing business in the long-run. It enables IT-based strategy development using the current resources and diminishes the need of expert' assistance. Another barrier of IT adoption in SMEs is the common perception that the technology adoption cost outweighs its benefit. The proposed framework works on this perception by initiating the IT adoption process from the enterprise's business perspective.

Several research works have addressed the importance of simplicity in model and framework development such as the unified framework of the business model concept (Al-Debei and Avison, 2010), the framework for assessing the business value of IT infrastructures (Kumar, 2004), a simplified model for performing a quick and easy usability and adoption evaluation of a recommender system (Pu and Chen, 2011), a role-based access control model (Takabi et al., 2010) and business model conceptualisation in digital entrepreneurship (Standing and Mattsson, 2016). Simplicity supports agility and flexibility, which are an enterprise's essential capabilities to achieve sustainable competitive advantage (Overby et al., 2006; Tallon and Pinsonneault, 2011). Agility enhances responsiveness in formulating an IT-based competitive strategy and revising the previous strategy due to the changes in the environment. Business environment is always changing, especially in today's digital economy environment. Hence, responsiveness to adapt to change is important. The framework facilitates a rapid IT strategy formulation and revision because the content covers only necessary elements. Since the result of the framework application is obtained based on a holistic approach, it

also provides some degree of flexibility. The flexibility could accelerate enterprise adaptability to change.

Most participants from the first and second evaluation agree that the proposed framework is potentially helpful for the targeted users with some suggestions for improvement. IT practitioners from national state company and consulting firm suggested combining the proposed framework with other established methodologies. Another justification why we retain the simplicity is to enable extensibility in the framework application. Enterprises can use and combine the framework with other methodologies, instruments, or frameworks as necessary. For example, the IT-based competitive strategy obtained from applying the framework may serve as input for strategy implementation in a strategic planning process.

Another suggestion from the case study application is related to the prioritisation of strategy implementation. The proposed framework does not specify the prioritisation, but managers can adopt one or more prioritisation techniques in software requirements or in IT project prioritisation to setup the strategy implementation. Some prioritisation methods in software requirements are a genetic algorithm approach to maximise the weigh benefit for all stakeholders (Achimugu et al., 2014), value oriented requirements prioritisation (Azar et al., 2007) and a data mining technique to prioritise requirements based on stakeholders' interests, business goals and cross-cutting concerns (Duan et al., 2009). In addition, some examples of IT project prioritisation are agile project management (Stettina and Hörz, 2015) and an IT project evaluation technique (Asosheh et al., 2010).

7.2 Implications for managerial practice

The findings on the development and application of IT-based competitive strategy framework have several implications on the IT-business alignment efforts. First, SMEs could utilise the framework to develop IT strategy that best meets business requirements and resource constraints. Since most of SMEs do not have a dedicated IT department/expertise, this approach helps them adopting and adapting necessary technologies to keep operating in the competitive environment. Second, the proposed framework could be used as a quick tool to reassess the IT strategy. It enables a rapid IT evaluation to ensure the ongoing IT strategy implementation is still on the track.

For enterprises that experience IT chaos, the framework serves as a practical and quick solution to assist with the reorganisation of their IT management. When in chaos, it is easier to build the foundation from the beginning than to repair the turmoil IT management. The enterprise could use the proposed framework to build the underlying structure and continue refining the process with other methodologies as necessary.

7.3 Limitations and future studies

While most of the results obtained in this study correspond to our goals, the generalisability is limited. A more comprehensive case study application is necessary to further validate the framework and to continue the design science activities. The future study encompasses the framework application in SMEs, enterprises that experiences IT chaos and general enterprises and the framework refinement based on the application feedback and evaluation. The IT-based strategy framework is designed as an evolutionary

framework that develops over time. It is expected that the current framework will be enhanced by refining the current construct (i.e., the framework element) and relationships between constructs or adding new construct and relationship.

8 Conclusions

This study proposes a framework of IT-based competitive strategy to resolve the common challenges towards achieving IT-business strategic alignment. The results of this study support two main contributions. First, a framework of IT-based competitive strategy is presented to assist enterprises with optimising IT implementation for business outcome. The framework serves as practical guidance and first aid in an IT-based strategy formulation. The IT-business alignment is demonstrated from analysing the value driver of IT implementation based on an enterprise's vision, identifying business competitive factors and developing an IT-based strategy to optimise the competitive factors. Second, this study applies a simplified and practical approach in the framework construction. The framework's simplicity provides agility and flexibility, the essential capabilities of competitive advantage. Another advantage of the proposed framework is the extensibility to be utilised with other methodologies and models. The findings on this study have several implications on IT-business alignment efforts, particularly for SMEs and enterprises that experience IT chaos. Finally, while most of the results address the goals of this study, the generalisability is rather limited. Therefore, a comprehensive case study is required for improving the generalisability and refining the framework.

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Abstract

One of the key success factors in video game industry, including multiplayer video game (MVG), is the user's continuance intention. The MVG industry runs in a highly competitive market. Users can shift to another game as soon as they discover a slightly inconvenient issue. Thus, maintaining the user's enthusiasm in playing MVG for a long time is challenging for most games. The solution to prolong the users' engagement can be initiated by identifying all factors that facilitate the continuance use of playing MVG. This study applied uses and gratifications theory to examine seven variables (enjoyment, fantasy, escapism, social interaction, social presence, achievement, and self-presentation) and the moderating effects of age and gender on the MVG continuance intention. The data analysis and the model development were tested based on Partial Least Square method using the responses of 453 MVG users. The results revealed that enjoyment, fantasy, social interaction, achievement, and self-presentation significantly affected the continuance intention of playing MVG, with enjoyment being the strongest variable. The result also demonstrated the moderating effect of age and gender on the relation between independent variables and continuance intention. The results and findings offered additional insights into the system development to enhance the information system application.

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The Continuance Intention of User's Engagement in Multiplayer Video Games based on Uses and Gratifications Theory

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Abstract

One of the key success factors in video game industry, including multiplayer video game (MVG), is the user's continuance intention. The MVG industry runs in a highly competitive market. Users can shift to another game as soon as they discover a slightly inconvenient issue. Thus, maintaining the user's enthusiasm in playing MVG for a long time is challenging for most games. The solution to prolong the users' engagement can be initiated by identifying all factors that facilitate the continuance use of playing MVG. This study applied uses and gratifications theory to examine seven variables (enjoyment, fantasy, escapism, social interaction, social presence, achievement, and self-presentation) and the moderating effects of age and gender on the MVG continuance intention. The data analysis and the model development were tested based on Partial Least Square method using the responses of 453 MVG users. The results revealed that enjoyment, fantasy, social interaction, achievement, and self-presentation significantly affected the continuance intention of playing MVG, with enjoyment being the strongest variable. The result also demonstrated the moderating effect of age and gender on the relation between independent variables and continuance intention. The results and findings offered additional insights into the system development to enhance the information system application.

I. INTRODUCTION

One of the most essential technological innovations that have been integrated in human lives is information systems. The information systems have been utilized in almost all aspects of business, government, health, culture, education, and entertainment. All variations of information systems are classifiable into utilitarian and hedonic

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information systems [1]. The utilitarian information systems provide goal-oriented and focus to user productivity, whilst hedonic information systems emphasize the entertainment purpose. While the utilitarian systems have dominated the industry evolution, the development of hedonic information systems have risen over the past few years.

One of the most developed and widely-used hedonic information systems is multiplayer video game (MVG). This game rapidly expands as it offers entertainment, social interaction, and economic benefits. MVG enables multiple users to play game at the same time in the same environment and involves cooperation and/or competition interactions among the users [2], [3]. People play MVG for enjoyment and relaxation, to fulfil behavioral needs related to achievement and competition, and to earn rewards and incentive benefits. As the internet and social media technologies have advanced rapidly, a large number of multiplayer video games have been released and the game publisher have shifted the mechanism of game play from *pay-to-play* to *free-to-play* or *pay-for-additional features* [4]. Some examples of popular MVGs are World of Warcraft, DOTA, and Mobile Legends. The number of online game players has increased at a rapid rate as well. This situation has led to a competitive market for online games, especially multiplayer video games. The users or gamers can shift to another game as soon as they discover a slightly inconvenient issue [5]. They may change to another game because they simply want to try new game experiences [6], they find unresolved technical problems (e.g., error, flat game scenario), or they perceived that they have finished all challenges in the game. Therefore, keeping the users to play the same game for a long time becomes more challenging for most games. The solutions to prolong the users' engagement can be initiated by identifying all contributing factors that facilitates the continuance use of a system.

Previous works have examined the behavioral factors that influenced the acceptance [7], [8], adoption [9], [10], and continuance use [11], [12] of a system. In the case of multiplayer video games (MVG), where the game play supports individual achievement and includes social interaction between players, it is appropriate to examine the gamers' engagement based on uses and gratifications theory (UGT). UGT is a sociological theory that describes why and how people actively seek out specific media to satisfy specific needs [13]. Recent works have studied UGT to analyze the continuance use of computer-based media and computer-mediated communication [14], [15]. Based on uses and gratifications theory, the motivations to play MVG, the success of playing the game, and the gratifications achieved predict the continuance use of MVG.

To develop a robust solution for user's engagement problems, this study aims to identify the factors that affect the continuance intention of playing multiplayer video games based on uses and gratifications theory. The output of this study could provide recommendation for the game developers on how to increase user retention and loyalty. Additionally, this study assesses further the contributing factors by considering multiple aspects and explores its relevance to the hedonic information systems field. Research on the continuance intention of MVG may also have implications for increasing the success of information systems in general.

II. METHODS

The continuance intention of playing video game is affected by three gratifications, i.e. hedonic gratification (enjoyment, fantasy and escapism), utilitarian gratification (achievement and self-presentation) and social gratification (social interaction and social presence) [5]. We adopted H. Li et al. [5] approach to examine the contributing factors that affect users in playing multiplayer video game in the following six steps. The first step was determining the research model based on uses and gratifications theory, as presented in Fig. 1. The model consisted of seven variables, i.e., enjoyment, fantasy, escapism, social interaction, social presence, achievement, and self-presentation. The users perceive enjoyment when they can enjoy playing the game and interacting with other users. Fantasy allows the users to carry out activities that are not possible to do in the real world, such as transforming into imaginary characters and possessing magical abilities. Next, escapism allows the users to be immersed in the game environment to escape from the stresses of daily life. In the case of social interaction, MVG is considered as one of social places, where the users can develop social relationships and receive feedback from other users [16]. MVG also facilitates the communication between users via synchronization messages and other communication channels to denote social presence. Achievement in MVG involves challenges in the game-play that motivate the users to continue the game engagement. Lastly, self-presentation facilitates the development of self-image to others.

The methods continued with constructing the hypotheses. Based on the research model, this study applied the following hypotheses.

H1: enjoyment positively impacts the continuance intention of playing MVG
H2: fantasy positively impacts the continuance intention of playing MVG
H3: escapism positively impacts the continuance intention of playing MVG
H4: social interaction positively impacts the continuance intention of playing MVG

H5: social presence positively impacts the continuance intention of playing MVG
H6: achievement positively impacts the continuance intention of playing MVG
H7: self-presentation positively impacts the continuance intention of playing MVG
This study also investigated two demographic profiles, age and gender, as the moderating variables on the MVG continuance intention.

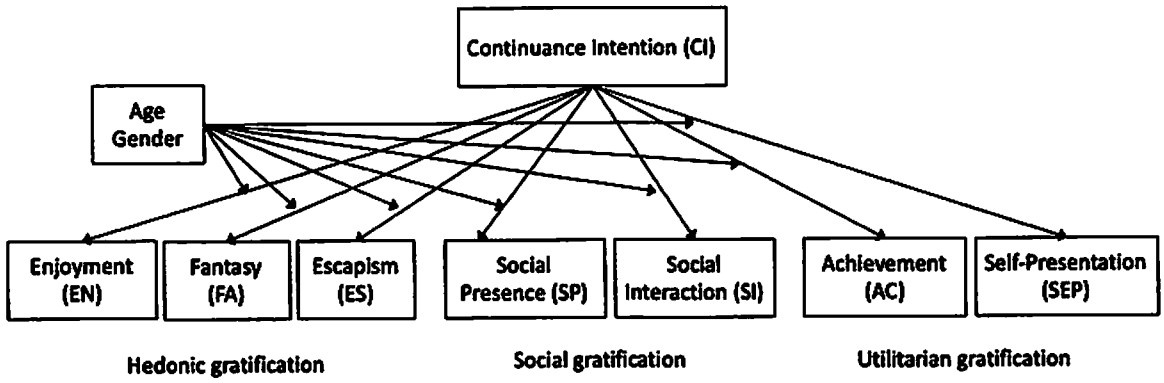


Fig. 1 The research model based on Uses and Gratifications Theory (adopted from [5])

The third step was collecting the data using online and offline (paper-based) questionnaires that consisted of demographics profiles and behavioral questions. The questionnaire was developed based on uses and gratifications theory instruments. The behavioral intention and all exogenous constructs were measured using 5-point Likert scale, i.e., strongly disagree (1), disagree (2), neutral (3), agree (4), and strongly agree (5). The recruited respondents were gamers with a minimum age of 18 years and had experiences of playing at least one MVG. The data collected from the participants was processed further in three phases, i.e., data tabulation, evaluation of the measurement model, and evaluation of the structural model. The data tabulation portrays the demographic profiles and described the respondents' answers. Evaluation of the measurement model tested the validity and reliability of the constructs. The last evaluation checked all data against structural equation modeling to determine the acceptance of the hypotheses. Drawing on the structural model evaluation, we analyzed the results and proposed recommendations pertaining to the users' continuance intention of playing multiplayer video game.

TABLE I
DEMOGRAPHICS PROFILE OF THE RESPONDENTS

Category	N (%), N=453
Gender	
Male	325 (71.7)
Female	128 (28.3)
Age	
< 16 years	32 (7.1)
16 – 20 years	208 (45.9)
21 – 25 years	213 (47.0)
Frequency of playing MVG	
Few times a day	276 (60.9)
Once a day	63 (13.9)
Few times a week	93 (20.5)
Once a week	21 (4.6)
Last playing MVG	
< 1 month	378 (83.4)
1 – 2 months	22 (4.9)
> 2 – 3 months	10 (2.2)
> 3 months	43 (9.5)

III. RESULTS

A. Demographic Profile of Respondents

A total of 465 respondents participated in the data collection, but only 453 responses were valid and included in the next data processing. The majority of the participants were male (71.7%). This gender profile confirmed prior studies that reported the majority of multiplayer video games were male [2], [5]. More than half of the participants

played MVG few times a day (60.9%) with the last playing time was less than one month (83.4%). Table I presents the demographic profile of the respondents.

B. Evaluation of the measurement model (outer model)

The evaluation of the measurement model consisted of validity test (convergent validity and discriminant validity) and reliability test. In a convergent validity test, the construct was valid if the loading factor > 0.7 [17]. Based on the convergent validity test in Table II, 23 indicators were valid, and 4 indicators were not valid. The validity test was repeated by eliminating the indicators with loading factor score below 0.7. The second validity test showed all indicators were valid (loading factor > 0.7), as shown in Table III. For discriminant validity test, the correlation value between two constructs was less than the square roots of the average variation extracted (AVE) of each construct, indicating a favorable discriminant validity.

TABLE II
CONSTRUCT, MEASUREMENT ITEM, AND LOADING FACTOR

Construct	Indicator	Measurement Item	Loading Factor
Enjoyment	EN1	I am interested in playing MVG	0.889
	EN2	I enjoy playing MVG	0.935
	EN3	I am happy playing MVG	0.926
Fantasy	FA1	I play MVG to experience things I cannot experience in real life	0.829
	FA2	I play MVG to act as another character	0.683
	FA3	I play MVG to immerse myself in the game environment	0.861
Escapism	ES1	I play MVG whenever I feel frustrated	0.784
	ES2	I like playing MVG when I experience a bad day	0.787
	ES3	I can let my anger out when I play MVG	0.738
	ES4	Playing MVG is the best way to temporarily escape from the real world	0.681
Social Interaction	SI1	I open more myself to others using MVG than via other communication media	0.668
	SI2	I have many friends by playing MVG	0.771
	SI3	Playing MVG allows me to connect with my friends in the real world	0.835
	SI4	Playing MVG allows me to keep in touch with my friends in the real world	0.738
Social Presence	SP1	I believe that another gamer will help me whenever I am in trouble	0.670
	SP2	I feel connected with other gamers when I play MVG	0.766
	SP3	I can be myself and I can show my real game-play to others in MVG environment	0.815
	SP4	I feel I am the member of a MVG community during the game playing	0.750
Achievement	AC1	I play MVG to reach higher levels	0.826
	AC2	I play MVG to get more power than other gamers	0.880
	AC3	I play MVG to have items or equipment that allow me to achieve higher position than other gamers	0.802
	AC4	I play MVG to show to other gamers that I am the best	0.794
Self-presentation	SEP1	I play MVG because I want other gamers recognize me as a cool gamer	0.807
	SEP2	I play MVG because I want other gamers perceive me as friendly	0.826
	SEP3	I play MVG because I want other gamers acknowledge my skill	0.936
Continuance Intention	CI1	Playing MVG is worthy	0.896
	CI2	I am willing to play MVG in the near future	0.884

TABLE III
RELIABILITY TEST

Construct	Composite Reliability	AVE	AC	CI	EN	ES	FA	SEP	SI	SP
AC	0,896	0.683	**0.826**							
CI	0,884	0.792	0.414	**0.890**						
EN	0,941	0.841	0.333	0.518	**0.917**					
ES	0,876	0.703	0.251	0.194	0.184	**0.838**				
FA	0,847	0.734	0.349	0.359	0.330	0.316	**0.857**			
SEP	0,893	0.736	0.482	0.161	0.166	0.269	0.303	**0.858**		
SI	0,857	0.668	0.289	0.478	0.464	0.229	0.351	0.258	**0.817**	
SP	0,835	0.628	0.381	0.445	0.492	0.255	0.451	0.272	0.531	**0.792**

Note: the bold number is the square root of AVE. The subsequent numbers below the bold number in the same column show the correlation value between two constructs.

The reliability test was evaluated based on the composite reliability and AVE scores. The composite reliability checked the internal consistency, while AVE measured the amount of variance that is captured by a construct relative to the amount of variance due to measurement error [18], [19]. The favorable reliability is achieved if the composite reliability score > 0.7 and AVE score > 0.5 for each construct [8]. Table III exhibits the validity and the reliability of all constructs. Thus, the measurement model evaluation was accepted.

C. *Evaluation of the structural model (inner model)*

The structural model in this study was developed based on Partial Least Square (PLS) SEM. To evaluate the structural model, the significance α was set to 0.05. Table IV presents the *p-value* of the inner model. Based on the *p-value* and path analysis, achievement, enjoyment, fantasy, self-presentation, and social interaction variables had significant impacts on the continuance intention of playing MVG (all inner *p-value* were less than 0.05). On the other hand, escapism and social presence variables did not correspond to continuance intention (all inner *p-value* were greater than 0.05).

TABLE IV
INNER MODEL EVALUATION

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	Path coefficient (β-value)	P-value
AC → CI	0.245	0.242	0.054	4.530	0.245	0.000
EN → CI	0.276	0.277	0.054	5.114	0.276	0.000
ES → CI	0.009	0.011	0.044	0.204	0.009	0.838
FA → CI	0.098	0.096	0.047	2.114	0.098	0.035
SEP → CI	-0.116	-0.104	0.046	2.524	0.116	0.012
SI → CI	0.231	0.232	0.054	4.289	0.231	0.000
SP → CI	0.078	0.078	0.057	1.353	0.078	0.177

The second structural model evaluation incorporated age and gender variables as the moderators between behavioral motivation and continuance intention of playing MVG. The result is shown in Table V. According to the results, age moderated the effects of achievement, enjoyment, fantasy, self-presentation, and social interaction. Similarly, the moderation role of gender on achievement, enjoyment, fantasy, self-presentation, and social interaction variables was significant (all p-value were less than 0.05).

TABLE V
PATH ANALYSIS OF AGE AND GENDER MODERATION

	Age moderation effect		Gender moderation effect	
	Path coefficient (β-value)	P-value	Path coefficient (β-value)	P-value
AC → CI	0.245	0.000	0.245	0.000
EN → CI	0.276	0.000	0.276	0.000
ES → CI	0.009	0.835	0.009	0.830
FA → CI	0.098	0.041	0.098	0.028
SEP → CI	-0.116	0.010	-0.116	0.011
SI → CI	0.231	0.000	0.231	0.000
SP → CI	0.078	0.170	0.078	0.165

The subgroup analysis of the basic research (age and gender subgroups) model is shown in Table VI.

TABLE VI
SUBGROUP ANALYSIS OF THE BASIC RESEARCH

	Age			Gender	
	<16	16 - 20	21 - 25	Male	Female
AC → CI	$\beta = 0.357$, $p = 0.202$	$\beta = 0.256$, $p = 0.001$	$\beta = 0.114$, $p = 0.111$	$\beta = 0.261$, $p = 0.000$	$\beta = 0.120$, $p = 0.146$
EN → CI	$\beta = 0.364$, $p = 0.254$	$\beta = 0.225$, $p = 0.002$	$\beta = 0.301$, $p = 0.000$	$\beta = 0.202$, $p = 0.001$	$\beta = 0.471$, $p = 0.000$
ES → CI	$\beta = -0.042$, $p = 0.880$	$\beta = -0.022$, $p = 0.697$	$\beta = 0.078$, $p = 0.249$	$\beta = 0.005$, $p = 0.919$	$\beta = 0.047$, $p = 0.607$
FA → CI	$\beta = 0.298$, $p = 0.165$	$\beta = 0.068$, $p = 0.322$	$\beta = 0.121$, $p = 0.058$	$\beta = 0.098$, $p = 0.058$	$\beta = 0.091$, $p = 0.278$
SEP → CI	$\beta = 0.081$, $p = 0.784$	$\beta = -0.091$, $p = 0.182$	$\beta = -0.161$, $p = 0.235$	$\beta = -0.135$, $p = 0.011$	$\beta = 0.066$, $p = 0.672$
SI → CI	$\beta = -0.143$, $p = 0.592$	$\beta = 0.241$, $p = 0.002$	$\beta = 0.228$, $p = 0.004$	$\beta = 0.222$, $p = 0.000$	$\beta = 0.177$, $p = 0.158$
SP → CI	$\beta = -0.007$, $p = 0.982$	$\beta = 0.180$, $p = 0.020$	$\beta = 0.025$, $p = 0.758$	$\beta = 0.173$, $p = 0.009$	$\beta = -0.149$, $p = 0.176$

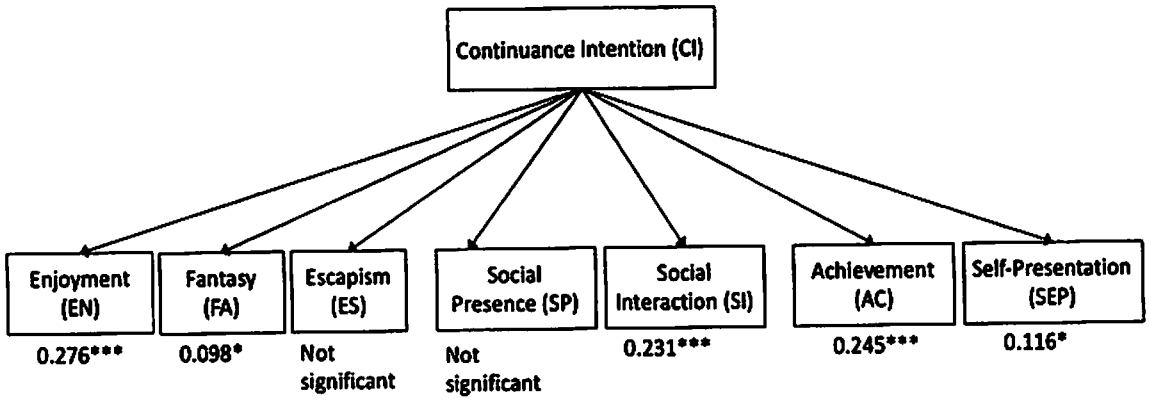
IV. DISCUSSION

A. Factors affecting the continuance intention of playing MVG

This study explores what factors influence game users to engage in playing multiplayer video games based on uses and gratifications theory. The inner model evaluation result is summarized in Fig. 2. The positive correlation in H1 and H2 shows that enjoyment and fantasy motivate the user to keep playing MVG. This type of game is a hedonic system that focuses on entertainment, therefore it is easy for the users to sense the enjoyment, such as when successfully striking the opponent, winning the competition, or accumulating rare items. This result is in line with prior studies that reported enjoyment affected user repurchase intention in online shopping [20], [21]. Likewise, MVG offers various storylines that enable the users to carry out activities that they cannot do in the real life and to pretend to be any characters (such as heroes, animals, fantasy creatures, celebrities, and soldiers). This finding in fantasy is similar to Kim et. al. study [22] that stated that fantasy is an important factor motivating the user engagement with an online game. In contrast with previous work, escapism does not affect the continuance intention of playing MVG in this study (H3). A possible explanation is some users play MVG as their occupation or to earn additional income, therefore playing MVG is part of their works and does not entirely cut off from reality.

In social gratification, only social interaction positively affects the continuance intention of playing MVG, as shown in H4. Users play MVG because they want to interact with other users in the game in various roles, for example as a competitor, a partner, or a mediator. MVG also provides communication channels and facilitates the community development. Interactions among the users and participation in MVG community may develop into a more intense relationships and could motivate the users to keep playing the game. On the other hand, social presence does not have a significant impact on the MVG continuance intention, as demonstrated by H5 rejection. Some users play MVG thoroughly for enjoyment and entertainment, thus they are not concerned with social attachment in the game.

The positive correlation in H6 and H7 reveals that the utilitarian gratification significantly influences the continuance intention of playing MVG. The main goal of playing MVG is related to achievement, such as finishing the game storyline with the highest score, acquiring rare game items, or defeating the opponent team. It brings the sense of satisfaction and the feeling of well-being. Longer game play and more accomplishments urge the users to achieve even higher success, thus prolonging their engagement with the game. This finding is similar with past works that mentioned achievement as one of the most important motivation to play video games [23] or online role-playing games [24]. Lastly, self-presentation also motivates the user to play MVG. The game enables the user to develop a particular image that they aspire to be perceived for, for example as a proficient and likeable game player. User are willing to spend hours of time on playing the game to attain the desired self-presentation.



*Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$*

Fig. 2 Summary of inner model evaluation

The moderation effect of gender in this study is consistent with prior studies in online games [5]. According to the result in Table VI, enjoyment was found to have a stronger impact on the continuance intention in the female subgroup than in the male group. While in the male subgroup, the continuance intention is also affected by

achievement, social interaction, and social presentation. This finding suggests that males are likely to be more engaged in playing MVG than females because their motivation is more extensive than just seeking enjoyment.

In term of age subgroups (see Table VI), the result reveals some interesting findings. Users between 16 to 20 years old are motivated by achievement, enjoyment, social interaction, and self-presentation. Achievement in this age subgroup is found to have a strongest impact because the users are much interested in collecting rare items, completing campaigns, and acquiring higher position in the virtual world. On the other hand, users in the 21 – 25 years subgroup are influenced by enjoyment and social interaction on the MVG continuance intention. These users are more likely to play MVG for entertainment and relaxation, e.g., to reduce the stress at work and in daily life.

B. Implication and Future Research

In view of the increasing advance of multiplayer video games, as well as the considerable number of respondents (n=453) acquired, this study offers beneficial contributions to the user's behavioral study in hedonic information systems, despite some of the hypotheses being not valid. The identified contributing variables on the MVG continuance intention can be adopted to other hedonic information systems and utilitarian information systems. It is important for other information systems, particularly business information systems, online commerce, and marketing systems, to ensure that their users and customers keep using the system because it determines the system success.

The first variable, enjoyment, can be incorporated in the information system development by analyzing user tasks and designing enjoyable user experiences. Likewise, fantasy draws users to utilize and to explore the system. Some examples of the fantasy implementation are emoji, virtual customer service, and profile avatar. The variable social interaction also invigorates the intention to keep using the system. Nowadays, collaborative and interconnected works have replaced the traditional ways to deliver superior results efficiently More software and applications are designed to facilitate collaborative works by implementing cloud-based platform, communication channels, and social networks. Users adhere to specific system to support their social interaction with other colleagues for completing their tasks.

Utilitarian gratifications play important roles in the system usage. The achievement variable should be considered in the system development. The more users acquire rewards, the longer they use the system. Some of the applications are giving away vouchers or gift cards for e-commerce users after they have spent a certain amount, membership tier and loyalty program, and releasing hidden features after users have acquired specific goals. The last variable, self-presentation, can be implemented in the rating system. Users continue use the system to enhance their rating for economic and social purposes. In resource sharing applications, such as Uber, AirBNB, and Gojek, both producers and consumers put efforts to maintain their excellent rating by keep using the system and providing better services. Higher rating enables more economic advantages and social opportunities.

While most of the results correspond to the goals of this study, a further validation is required. Future study should improve the data collection by involving larger respondents from various demographic profiles to acquire more significant results. The next improvement is investigating other moderating variables, such as occupation and income.

V. CONCLUSIONS

This study investigates the impact of users' gratifications on their continuance intention of playing MVG. The results of this study support two main conclusions. First, the influenced factors that support the MVG continuance intention are enjoyment, fantasy, social interaction, achievement, and self-presentation. Second, all three gratifications (hedonic, social, and utilitarian) affect the continuance intention in hedonic information systems. At the beginning of use, users tend to be influenced by hedonic and social gratifications. The more the users play MVG, the utilitarian gratification (achievement and self-presentation) becomes more significant as the users have achieved accomplishments that correspond to their utilitarian needs. The results and findings from this study offer additional insights into the system development to enhance the information system application.

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LAMPIRAN 4 Luaran Penelitian 4: Seminar Internasional

Luaran penelitian 4 adalah artikel yang di-*submit* ke seminar internasional.

Judul Makalah:	**A User-centered Design for Redesigning E-Government Website in Public Health Sector**
Nama Temu Ilmiah:	**3rd International Seminar on Application for Technology of Information and Communication**
Tempat:	**Universitas Dian Nuswantoro, Semarang, Indonesia**
Waktu Pelaksanaan:	**21-22 September 2018**
Status:	**Telah Dilaksanakan**

Bukti penerimaan makalah.

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ISEMANTIC'18- Letter of Acceptance - 1570479943 A User-centered Design for Redesigning E-Government Website in Public Health Sector

message

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Reply-To: isemantic@lppm.dinus.ac.id
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A User-centered Design for Redesigning E-Government Website in Public Health Sector

An Approach to Improve the User Experience

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***Abstract*— The rising awareness of information transparency and the increasing citizen participation in "healthy living for healthy societies" campaign have promoted the effectuation of e-government service in public health sector. As one of the government agencies, Surabaya Health Department (SHD), Indonesia, is responsible to provide public health services and to administer health-related policies in Surabaya city. The department has been utilizing an official website to deliver its tasks and responsibilities. However, the website was built mostly based on the department's perspective and internal consensus, without a proper requirement gathering from users and stakeholders. This subjectivity has caused some essential unfulfilled, thus nullified the website goals.**

This study aims to redesign the official SBD website to improve the information dissemination quality and the user experience. The website development follows user-centered design (UCD) methodology. The output consists of user requirements, user task analysis, and a redesigned SHD website prototype. The heuristic evaluations between the existing and the new redesigned websites demonstrate the improvement of user experience. The UCD also enables the user identification and the corresponding requirements more comprehensively. One of the examples is the inclusion of specific requirements for person with color-blind and person with dyslexia in the redesigned SHD website.

Keywords—user-centered design; UCD; usability; public health website; heuristic evaluation; user experience

I. INTRODUCTION

The World Wide Web is arising as one of the major health information sources. Consumers of non-medical professionals, have been extensively utilized health websites to fulfil their health information needs, including access to government policy on health and social care information. The increasing citizen participation in "healthy living for healthy societies" campaign, especially via electronic system, has promoted the effectuation of e-government services in public health sector. Government agencies have developed official websites as one of the core media to deliver the public health services, such as informing verified public health information, promoting healthy life style, preventing the spread of communicable disease, and assuring adequate local public health services.

Delivering public health information electronically requires meticulous and advanced information processing, rigorous evaluation, and strict compliance to standards. To effectively facilitate the presentation of health information, it is essential to design the system based on the user's needs and to incorporate interaction design and usability principles [1]. Previous works also mentioned that usability positively influenced the user satisfaction on mobile-based applications [2], perceived usability affected the continuance usage intention of Internet Banking [3]. In mobile health applications, implementing adequate usability on its development is crucial to ensure the correct exchange of health messages [4]. Delivering accurate health information in the correct presentation is important to avoid misunderstanding of health information as it may lead to harmful consequences [5], e.g., affecting a person's health, or worsening the patient's condition.

Incorporating usability principles and interaction design in a system development is mostly conveyed via its interface design. A good interface enables the users to perform their intended tasks effectively and efficiently without too much distraction. Some of the interface system design methodologies are User-Centered Design (UCD) and Activity-Centered Design (ACD). UCD works based on the needs and the interests of users with a focus of making the system usable and understandable [6], while ACD focuses on the activities that the users will carry out or should be able to perform by using the designed system [7]. ACD is mostly used to design a system where the user groups are heterogenous and the usage goals are varied, but the activities that the users carry out are more common [7]. This study applies UCD because a health-related system must accommodate users' requirements thoroughly to ensure the delivery of relevant and correct health. Therefore, involving user throughout the system development is essential [8]. The UCD design process consists of specifying the context of use, specifying the user and organizational requirements, designing the solution, and evaluating the solution against the requirements [9].

As one of the government agencies, Surabaya Health Department in Indonesia is responsible to provide public health services and to administer health-related policies in Surabaya city. The department has been utilizing an official website to deliver its tasks and responsibilities to Surabaya society. However, the website was built mostly based on the department's perspective and internal consensus, without a proper requirement gathering from users and stakeholders. This subjectivity has caused some essential requirements in a public health system unfulfilled, thus nullified the website goals. Often times, the users were unable to find the public health information they were looking for. Given the current problems in the existing official website, this research aims to redesign the website of Surabaya Health Department to improve the information dissemination quality and the user experience. The proposed solution is developed based on UCD methodology.

II. Research Methodology

This research adopted user-centered design methodology to redesign the official website of Surabaya Health Department. The method consisted the following four phases. The first phase was specifying the context of use by identifying the user and assigning the context of use. To identify the user, we conducted literature study and interviewed the manager of the website from Surabaya Health Department. The purpose of the interview was to gather requirements from the public health service provider's perspective. To assign the context of use, we evaluated the existing websites based on the users' and experts' perspectives using heuristic evaluation. The questionnaire for the heuristic evaluation was developed based on the application of heuristic evaluation in [10], [11]. The questionnaire consisted of ten heuristic indicators, i.e., aesthetic and minimalist design; visibility of system status; match between system and the real world; recognition rather than recall; consistency and standards; flexibility and efficient of use; use control and freedom; error prevention; help users recognize, dialogue, and recovers from errors; and help and documentation. The indicators were measured using 4-point Likert scale, i.e., strongly disagree (1), disagree (2), agree (3), and strongly agree (4). The participants were the users of the existing website, two information system analysts, two public health practitioners, two visual communication designers, and two psychology students.

The second and the third phases were related to the UCD system development. The second phase, specifying the user requirements, identified the user needs and analyzed the user tasks from a public health website. The output of this phase included requirements specification, user tasks analysis, use case diagram, and sequence diagram. The third phase, designing the solution, transformed user requirements into the system blueprint that consisted of the layout design, a storyboard design, and the user interface mock-up. The solution in this study focused on the interaction design via the system interface.

The last phase was evaluating the proposed solution against the requirements using heuristic evaluation method. The evaluators were the same participants who assessed the existing website of Surabaya Health Department in the first phase. The research methodology in this study is depicted in Figure 1.

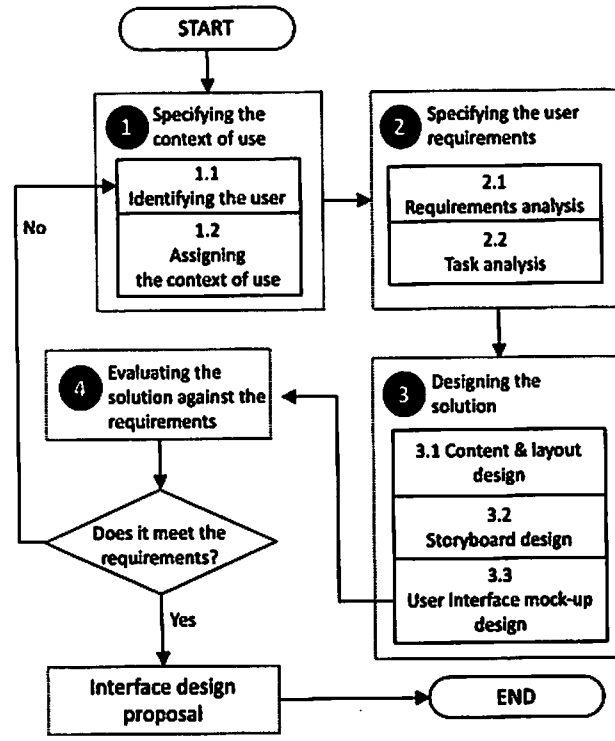

Fig. 1. Research methodology

III. Results: The Website Design Based on UCD

A. User Identification

Based on the interview with the manager of Surabaya Health Department website and literature study in public health, there were three user classes as elaborated in Table I. Each user classes used the website for specific purpose and carried out different tasks.

TABLE I. User Identification

User class	Profession	Organizational Environment	Usage Purpose
Health service provider	1. Hospital staff 2. Community Health Center staff	Hospital, CHC, Specialist Clinics, Drugstore, University	Input health report
	3. Physician / midwife 4. Pharmacist 5. Nutritionist 6. Health analyst 7. Academics		Verify health information, provide public health service, administer online health-related license application
Government stakeholder	1. City government 2. City council	Government office	Monitor the health service provider performance, draw and issue public health policy
Society	1. Citizen 2. Journalist	The city of Surabaya, TV studio, Radio station, News agency	Access public health and healthcare facility information, consult public health matter, download health data.

B. *Assigning the Context of Use (Heuristic Evaluation 1)*

Assigning the context of use involved collecting the user feedback and evaluating the usage of the existing Surabaya Health Department website. Each heuristic indicator consisted specific questions. All answers from all participants for each question was tabulated using the behavior measurement scale [12]. The result of each question was then interpreted based on four interval scales, as shown in the Likert scale. The result of the heuristic evaluation is elaborated in Table II.

TABLE II. THE RESULT OF EXISTING WEBSITE EVALUATION (HEURISTIC EVALUATION 1)

Heuristic Indicator	Question Code	Tabulated Score	Interval Interpretation
Aesthetic and minimalist design	AE1	50%	Disagree
	AE2	55%	Agree
	AE3	46%	Disagree
Visibility of system status	VI1	48%	Disagree
	VI2	53%	Agree
	VI3	58%	Agree
	Vi4	65%	Agree
	VI5	48%	Disagree
Match between system and the real world	MA1	56%	Agree
	MA2	43%	Disagree
	MA3	70%	Agree
Recognition rather than recall	RE1	55%	Agree
	RE2	50%	Disagree
Consistency and standards	CO1	53%	Agree
	CO2	48%	Disagree
	CO3	63%	Agree
Flexibility and efficient of use	FL1	46%	Disagree
	FL2	50%	Disagree
Use control and freedom	US1	51%	Agree
	US2	48%	Disagree
Error prevention	ER1	55%	Agree
	ER2	48%	Disagree
Help users recognize, dialogue, and recovers from errors	HE1	56%	Agree
Help and documentation	HD1	45%	Disagree

C. *Requirement Analysis*

The user requirement analysis incorporated all participants' feedbacks in the heuristic evaluation 1. The result is shown in Table III.

TABLE III. THE PROPOSED REQUIREMENT BASED ON USER'S FEEDBACK FROM THE HEURISTIC EVALUATION 1

No.	Proposed Requirement	Participant
1.	User interface redesign	P1, P3, P4, P7, P8, P9, P10, P11, and P12
2.	Search tools to seek information about health care service	P1, P4, P5, P10, P12, P13, and P15
3.	Direct and real time communication between the user and the staff of Surabaya Health Department	P1, P3, P10, and P11
4.	Inclusion of health data and public health documentation in the website	P2 and P4
5.	Online processing of clinic operating permit	P7, P12, and P15
6.	A user's feedback facility	P4

D. *Task Analysis*

The users' tasks analysis integrated the user identification from the service provider perspective and the requirements from the user's perspective. Table IV shows the task analysis result for each defined user class.

TABLE IV. THE USERS' TASKS

User Class	Task	
Health service provider	1.1	Access Surabaya Health Department website
	1.2	Supply verified and accurate public health information (including health-related news, health-care facilities, and public health policy)
	1.3	Seek public health information
	1.4	Administer online health-related license application
	1.5	Upload health data and public health report / documentation
Govern-ment stake-holder	2.1	Access Surabaya Health Department website
	2.2	Seek public health information
	2.3	Monitor the Surabaya Health Department activities by assessing the posted content related to public health activities in Surabaya city.
Society	3.1	Access Surabaya Health Department website
	3.2	Seek public health information
	3.3	Access public health service
	3.4	Consult public health matter with the staff of Surabaya Health Department
	3.5	Submit feedback related to the website and public health activity
	3.6	Download health data and public health report / documentation

The task analysis also produced use cases, scenario, and the sequence diagram. The use case consisted of three actors and eleven use cases.

E. *Designing the Solution: the Content Design*

The first activity of designing the solution was constructing the content design. Content should be constructed consistently, it defines the layout, the structure, and the outline of all website

content. In this study, the content design focused on the aesthetics and the navigational design.

1) Aesthetics Design

The aesthetic design included the theme colors, layout, and font-schemes. The selected theme colors for the proposed new website were blue (hex code: #0088cc), black (hex code: #383f48), and white (hex code: #FFFFFF). We selected the theme colors to accommodate the color-blind users in the society of Surabaya. About 95% of color-blind population is unable to distinguish green and red colors. Surabaya Health Department also requested the blue color as it is the institutional color.

The website layout is presented in Fig. 2. The main menu, that showed the highest level of user interaction, was located on the top of the page and the side menu (if available) was located on the left part. Since the redesigned website belongs to website with specific topics and interest group, placing the top priority content on the top menu enables greater exposure. This allows the user to find the most important website content faster and easier. The submenu on the left page also facilitated quick eye scanning about the overall structure of a website [13]. The submenu position is more preferable on the left side than on the right side because it is more suitable with the reading direction in Indonesian language and English.

In this first website redesign, the user requirements included specific needs for people with color blind and people with dyslexia. According to International Dyslexia Association, around 10% of people have dyslexia [14]. Thus, we selected the font-schemes with the highest readability to facilitate reading for person with dyslexia, i.e., Helvetica, Arial, and Verdana [14].

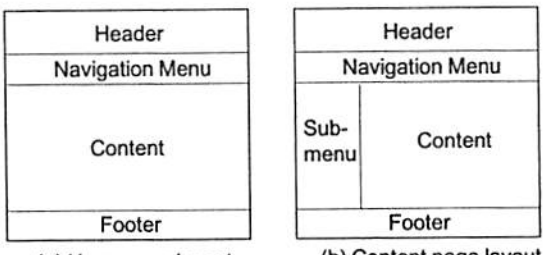

Fig. 2. The layout-design

2) Navigational Design

The website navigation was placed on the top page and constructed based on the hierarchical structure. The top menu consisted of Home, *Tentang Kami* (profile), *Layanan Publik* (public service), *Informasi Publik* (public information), *Download* (health data and report), and *Pojok Kesmas* (*Community Health Center Corner*). Some of the main menu can be decomposed further into several submenu, such as the *Layanan Publik* menu. *Layanan Publik* consisted of E-health, *Pelayanan Puskesmas* (Community Health Center service), *Pelayanan Sarana Kesehatan* (public health facility service), *Perijinan Online* (*online health-related license application*). Fig. 3. depicts the hierarchical structure of the web navigation.

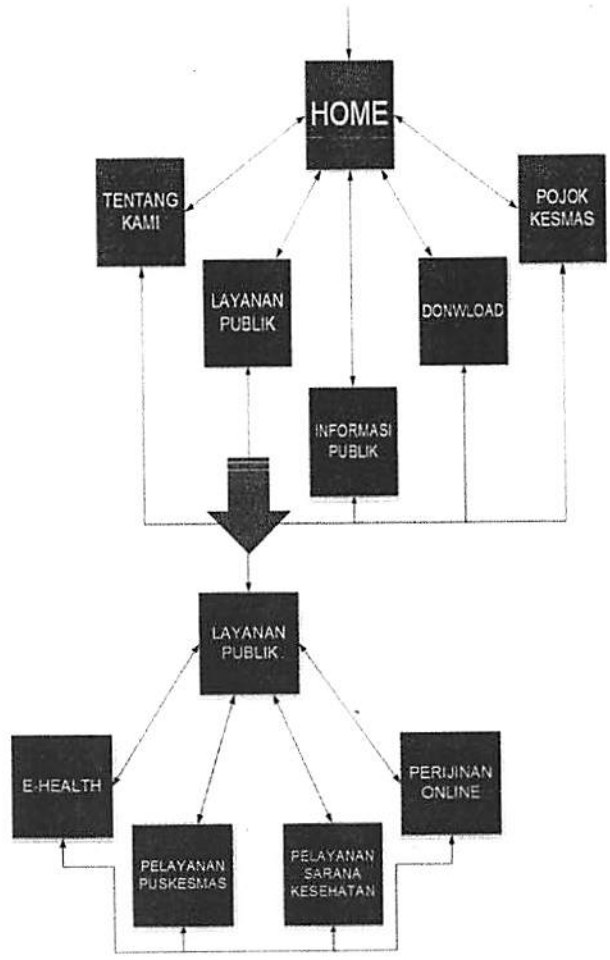

Fig. 3. The web structural navigation. The translation labels in English are the following: Tentang Kami (SHD Profile), Layanan Publik (Public Service), Informasi Publik (Public Information), Download (Health Data and Report), Pojok Kesmas (Community Health Center Corner), Pelayanan Puskesmas (Community Health Center Service), Pelayanan Sarana Kesehatan (Public Health Facility Service), and Perijinan Online (Online Health-related License Application)

F. Designing the Solution: Storyboard and Mock-Up

The storyboard visualizes the possible scenario of user interaction on each webpage. It also facilitates the exploration of user experience with the website. We developed the storyboard for each webpage based on the user requirement and the task analysis. An example of storyboard for homepage is shown if Fig. 4. The last step on designing the solution was building the website prototype based on the mock-up approach. Fig. 5. shows the example of homepage prototype.

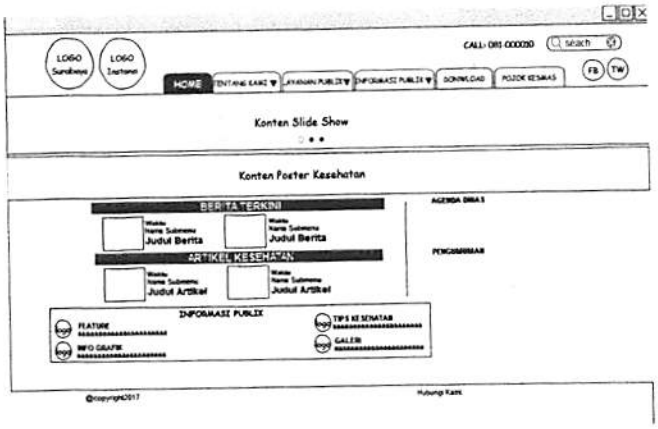

Fig. 4. Storyboard of SHD homepage website

Fig. 5. The homepage mock-up (in Indonesian language)

G. Evaluating the Solution Against the Requirements (Heuristic Evalution 2)

We conducted heuristic evaluation 2 to evaluate the correctness and the completeness of the developed solution, i.e., the new website prototype. The heuristic evaluation 2 used the same questionnaire and the same participants as in heuristic evaluation 1. Table V shows the heuristic evaluation 2 results.

TABLE V. THE RESULT OF NEW WEBSITE EVALUATION (HEURISTIC EVALUATION 2)

Heuristic Indicator	Question Code	Tabulated Score	Interval Interpretation
Aesthetic and minimalist design	AE1	90%	Strongly agree
	AE2	85%	Strongly agree
	AE3	75%	Agree
Visibility of system status	VI1	85%	Strongly agree
	VI2	90%	Strongly agree
	VI3	90%	Strongly agree
	Vi4	80%	Strongly agree
	VI5	90%	Strongly agree
Match between system and the real world	MA1	85%	Strongly agree
	MA2	90%	Strongly agree
	MA3	90%	Strongly agree
Recognition rather than recall	RE1	85%	Strongly agree
	RE2	85%	Strongly agree
Consistency and standards	CO1	85%	Strongly agree
	CO2	85%	Strongly agree
	CO3	70%	Agree
Flexibility and efficient of use	FL1	95%	Strongly agree
	FL2	90%	Strongly agree
Use control and freedom	US1	90%	Strongly agree
	US2	90%	Strongly agree
Error prevention	ER1	85%	Strongly agree
	ER2	80%	Strongly agree
Help users recognize, dialogue, and recovers from errors	HE1	80%	Strongly agree
Help and documentation	HD1	90%	Strongly agree

The new website evaluation (heuristic evaluation 2) exhibits improvements in all heuristic indicators compared to the existing website evaluation (heuristic evaluation 1). Only one question in one indicator scores below 75%, i.e., the question about the content update consistency (OC3). It occurs because the new website is still in the development phase, thus the content is not updated frequently. These improvements confirm that the user-centered development can capture the user requirement more comprehensively, thus increases the likelihood of system success. One of the examples is the inclusion of specific requirement for person with color-blind and person with dyslexia.

While most of the results correspond positively to the purpose of this study, further iterations of user-centered design are necessary to complete the new redesigned website. Further evaluation should be conducted by involving larger participants and representatives from the government stakeholders.

IV. DISCUSSION

This paper proposes the application of UCD to redesign a public health agency website, i.e., the Surabaya Health Department in Surabaya city. The UCD ensures the website development incorporating all users' needs. This is essential because the Surabaya Health Department website delivers public health information to broad audiences. Error and mistake in health information delivery can cause fatal consequences. Another consideration in the website development is the involvement of experts and practitioners from multidiscipline fields to assure the delivery of accurate health information in the correct presentation.

V. Conclusion

This study applies the user-centered design to develop a website that can improve public health communication and health information exchange between a government agency (i.e., Surabaya Health Department) and the society of Surabaya. The results of this study support three main contributions, i.e., a detail identification of the targeted users, the inclusion of specific requirements for users with special needs, and the application of UCD to improve the user experience. The enhancement of the user experience is exhibited in the heuristic evaluation scores between the existing website and the new redesigned website.

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LAMPIRAN 5 Luaran Penelitian 5: HKI Hak Cipta 1

Judul HKI:	Stakeholder's Expected Value of Enterprise Architecture, An Enterprise Architecture Solution based on Stakeholder Perspective
Jenis:	Hak Cipta
No. Pendaftaran:	EC00201810658
Tahun Pendaftaran:	2018
Status:	***Granted***, No. HKI: **000107337**

Bukti sertifikat pencatatan ciptaan adalah sebagai berikut.

REPUBLIK INDONESIA
KEMENTERIAN HUKUM DAN HAK ASASI MANUSIA

SURAT PENCATATAN CIPTAAN

Dalam rangka pelindungan ciptaan di bidang ilmu pengetahuan, seni dan sastra berdasarkan Undang-Undang Nomor 28 Tahun 2014 tentang Hak Cipta, dengan ini menerangkan:

Nomor dan tanggal permohonan	:	EC00201810658, 30 April 2018
Pencipta		
Nama	:	**Ira Puspitasari, S.T., M.T., Ph.D.**
Alamat	:	Sukolilo Dian Regency Jl. Rejeki I No. 12 RT/RW 008/002 Kelurahan Keputih Kecamatan Sukolilo, Surabaya, Jawa Timur, 60111
Kewarganegaraan	:	Indonesia
Pemegang Hak Cipta		
Nama	:	**Ira Puspitasari, S.T., M.T., Ph.D.**
Alamat	:	Sukolilo Dian Regency Jl. Rejeki I No. 12 RT/RW 008/002 Kelurahan Keputih Kecamatan Sukolilo, Surabaya, Jawa Timur, 60111
Kewarganegaraan	:	Indonesia
Jenis Ciptaan	:	**Karya Ilmiah**
Judul Ciptaan	:	**Stakeholder's Expected Value Of Enterprise Architecture, An Enterprise Architecture Solution Based On Stakeholder Perspective**
Tanggal dan tempat diumumkan untuk pertama kali di wilayah Indonesia atau di luar wilayah Indonesia	:	8 Jun 2016, di Towson
Jangka waktu pelindungan	:	Berlaku selama hidup Pencipta dan terus berlangsung selama 70 (tujuh puluh) tahun setelah Pencipta meninggal dunia, terhitung mulai tanggal 1 Januari tahun berikutnya.
Nomor pencatatan	:	000107337

adalah benar berdasarkan keterangan yang diberikan oleh Pemohon.
Surat Pencatatan Hak Cipta atau produk Hak terkait ini sesuai dengan Pasal 72 Undang-Undang Nomor 28 Tahun 2014 tentang Hak Cipta.

a.n. MENTERI HUKUM DAN HAK ASASI MANUSIA
DIREKTUR JENDERAL KEKAYAAN INTELEKTUAL

Dr. Freddy Harris, S.H., LL.M., ACCS.
NIP. 196611181994031001

LAMPIRAN 6 Luaran Penelitian 6: HKI Hak Cipta 2

Judul HKI:	**The Impacts Of Consumer's Health Topic Familiarity In Seeking Health Information Online: A Solution Based On Consumer's Perspective In Health Information Search**
Jenis:	**Hak Cipta**
No. Pendaftaran:	**EC00201816854**
Tahun Pendaftaran:	**2018**
Status:	***Granted*, No. HKI: 000111047**

Bukti sertifikat pencatatan ciptaan adalah sebagai berikut.

REPUBLIK INDONESIA
KEMENTERIAN HUKUM DAN HAK ASASI MANUSIA

SURAT PENCATATAN
CIPTAAN

Dalam rangka pelindungan ciptaan di bidang ilmu pengetahuan, seni dan sastra berdasarkan Undang-Undang Nomor 28 Tahun 2014 tentang Hak Cipta, dengan ini menerangkan:

Nomor dan tanggal permohonan	:	EC00201816854, 3 Juli 2018
Pencipta		
Nama	:	**Ira Puspitasari, S.T., M.T., Ph.D.**
Alamat	:	Prodi Sistem Informasi, Fakultas Sains Dan Teknologi, UNAIR Kampus C Jl. Mulyorejo, Kota Surabaya, Jawa Timur, 60115
Kewarganegaraan	:	Indonesia
Pemegang Hak Cipta		
Nama	:	**Ira Puspitasari, S.T., M.T., Ph.D.**
Alamat	:	Prodi Sistem Informasi, Fakultas Sains Dan Teknologi, UNAIR Kampus C Jl. Mulyorejo, Kota Surabaya, Jawa Timur, 60115
Kewarganegaraan	:	Indonesia
Jenis Ciptaan	:	**Karya Ilmiah**
Judul Ciptaan	:	**The Impacts Of Consumer's Health Topic Familiarity In Seeking Health Information Online: A Solution Based On Consumer's Perspective In Health Information Search**
Tanggal dan tempat diumumkan untuk pertama kali di wilayah Indonesia atau di luar wilayah Indonesia	:	8 Juni 2017, di London
Jangka waktu pelindungan	:	Berlaku selama hidup Pencipta dan terus berlangsung selama 70 (tujuh puluh) tahun setelah Pencipta meninggal dunia, terhitung mulai tanggal 1 Januari tahun berikutnya.
Nomor pencatatan	:	000111047

adalah benar berdasarkan keterangan yang diberikan oleh Pemohon.
Surat Pencatatan Hak Cipta atau produk Hak terkait ini sesuai dengan Pasal 72 Undang-Undang Nomor 28 Tahun 2014 tentang Hak Cipta.

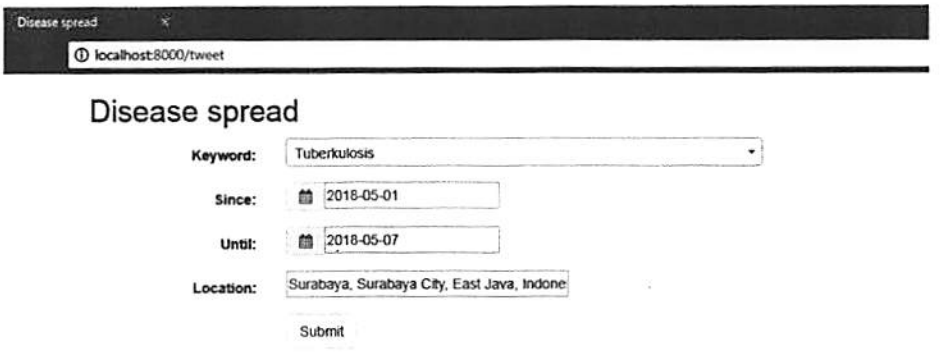
a.n. MENTERI HUKUM DAN HAK ASASI MANUSIA
DIREKTUR JENDERAL KEKAYAAN INTELEKTUAL

Dr. Freddy Harris, S.H., LL.M., ACCS.
NIP. 196611181994031001

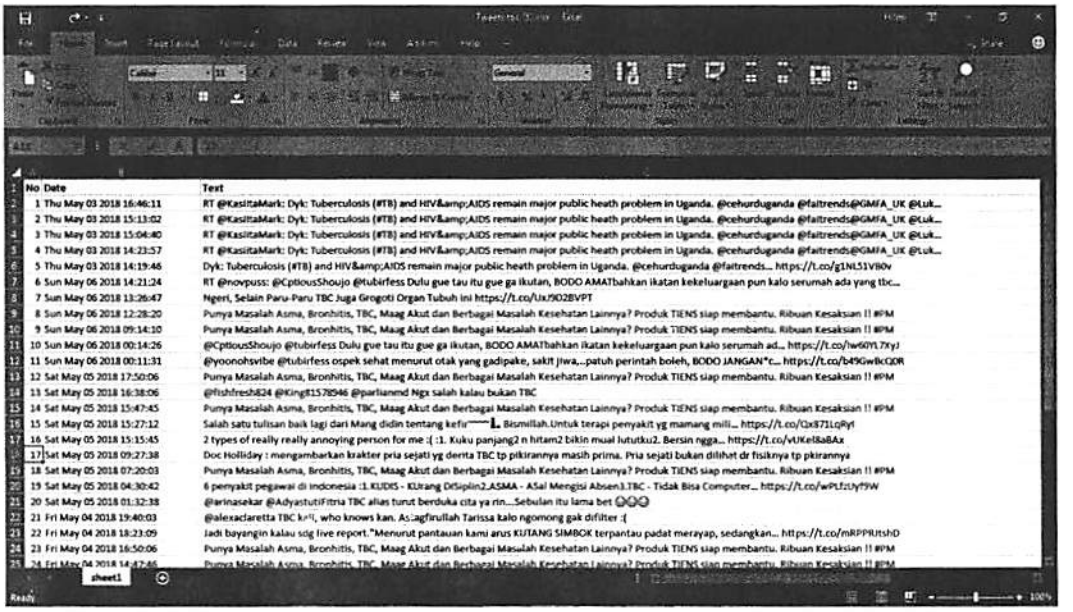
LAMPIRAN 7 Luaran Lain: Aplikasi Ekstraksi Data Twitter

Aplikasi yang dikembangkan untuk mengekstraksi data nonklinik dari media sosial Twitter. Data yang diekstraksi adalah data Twitter yang mengandung kata kunci spesifik (penyakit menular), data geolokasi, user, dan lokasi. Keluaran berupa data media sosial (dalam format .csv) yang akan diolah lebih lanjut untuk menganalisis pola penyebaran penyakit menular.

Tampilan antarmuka aplikasi:



Tampilan *output* hasil ekstraksi data:



No	Date	Text
1	Thu May 03 2018 16:46:11	RT @KasiitaMark: Dyk: Tuberculosis (#TB) and HIV&AIDS remain major public heath problem in Uganda. @cehurduganda @faitrends@GMFA_UK @Luk...
2	Thu May 03 2018 15:13:02	RT @KasiitaMark: Dyk: Tuberculosis (#TB) and HIV&AIDS remain major public heath problem in Uganda. @cehurduganda @faitrends@GMFA_UK @Luk...
3	Thu May 03 2018 15:04:40	RT @KasiitaMark: Dyk: Tuberculosis (#TB) and HIV&AIDS remain major public heath problem in Uganda. @cehurduganda @faitrends@GMFA_UK @Luk...
4	Thu May 03 2018 14:23:57	RT @KasiitaMark: Dyk: Tuberculosis (#TB) and HIV&AIDS remain major public heath problem in Uganda. @cehurduganda @faitrends@GMFA_UK @Luk...
5	Thu May 03 2018 14:19:46	Dyk: Tuberculosis (#TB) and HIV&AIDS remain major public heath problem in Uganda. @cehurduganda @faitrends... https://t.co/g1NL51VB0v
6	Sun May 06 2018 14:21:24	RT @novpuss: @CptiousShoujo @tubirfess Dulu gue tau itu gue ga ikutan, BODO AMATbahkan ikatan kekeluargaan pun kalo serumah ada yang tbc...
7	Sun May 06 2018 13:26:47	Ngeri, Selain Paru-Paru TBC Juga Grogoti Organ Tubuh ini https://t.co/UxJ9O2BVPT
8	Sun May 06 2018 12:28:20	Punya Masalah Asma, Bronhitis, TBC, Maag Akut dan Berbagai Masalah Kesehatan Lainnya? Produk TIENS siap membantu. Ribuan Kesaksian !! #PM
9	Sun May 06 2018 09:14:10	Punya Masalah Asma, Bronhitis, TBC, Maag Akut dan Berbagai Masalah Kesehatan Lainnya? Produk TIENS siap membantu. Ribuan Kesaksian !! #PM
10	Sun May 06 2018 00:14:26	@CptiousShoujo @tubirfess Dulu gue tau itu gue ga ikutan, BODO AMATbahkan ikatan kekeluargaan pun kalo serumah ad... https://t.co/hw60YL7XyJ
11	Sun May 06 2018 00:11:31	@yoonohsvibe @tubirfess ospek sehat menurut otak yang gadipake, sakit jiwa,..patuh perintah boleh, BODO JANGAN*c... https://t.co/b49GwBkCQR
12	Sat May 05 2018 17:50:06	Punya Masalah Asma, Bronhitis, TBC, Maag Akut dan Berbagai Masalah Kesehatan Lainnya? Produk TIENS siap membantu. Ribuan Kesaksian !! #PM
13	Sat May 05 2018 16:38:06	@fishfresh824 @King81578946 @parlianmd Ngx salah kalau bukan TBC
14	Sat May 05 2018 15:47:45	Punya Masalah Asma, Bronhitis, TBC, Maag Akut dan Berbagai Masalah Kesehatan Lainnya? Produk TIENS siap membantu. Ribuan Kesaksian !! #PM
15	Sat May 05 2018 15:27:12	Salah satu tulisan baik lagi dari Mang didin tentang kefir——L. Bismillah.Untuk terapi penyakit yg mamang mili... https://t.co/t3x871LqRyl
16	Sat May 05 2018 15:15:45	2 types of really really annoying person for me :(:1. Kuku panjang2 n hitam2 bikin mual lututku2. Bersin ngga... https://t.co/vUKel8a8Ax
17	Sat May 05 2018 09:27:38	Doc Holliday : mengambarkan krakter pria sejati yg derita TBC tp pikirannya masih prima. Pria sejati bukan dilihat dr fisiknya tp pkirannya
18	Sat May 05 2018 07:20:03	Punya Masalah Asma, Bronhitis, TBC, Maag Akut dan Berbagai Masalah Kesehatan Lainnya? Produk TIENS siap membantu. Ribuan Kesaksian !! #PM
19	Sat May 05 2018 04:30:42	6 penyakit pegawai di indonesia :1. KUDIS - KUrang DiSiplin2. ASMA - ASal Mengisi Absen3. TBC - Tidak Bisa Computer... https://t.co/wPLfzUyf9W
20	Sat May 05 2018 01:32:38	@arinasekar @AdyastutiFitria TBC alias turut berduka cita ya rin....Sebulan itu lama bet 😂😂
21	Fri May 04 2018 19:40:03	@alexadaretta TBC k^^, who knows kan. As:agfirullah Tarissa kalo ngomong gak difilter :(
22	Fri May 04 2018 18:23:09	Jadi bayangin kalau sdg live report."Menurut pantauan kami arus KUTANG SIMBOK terpantau padat merayap, sedangkan... https://t.co/mRPPRUtshD
23	Fri May 04 2018 16:50:06	Punya Masalah Asma, Bronhitis, TBC, Maag Akut dan Berbagai Masalah Kesehatan Lainnya? Produk TIENS siap membantu. Ribuan Kesaksian !! #PM
24	Fri May 04 2018 14:47:46	Punya Masalah Asma, Bronhitis, TBC, Maag Akut dan Berbagai Masalah Kesehatan Lainnya? Produk TIENS siap membantu. Ribuan Kesaksian !! #PM