Change and Compliance in Collaborative Processes

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***Abstract*—During their lifecycle, business processes are keen to change. Changes either concern the process model structure or the accompanying rules; e.g. compliance rules (laws and regulations). In the context of business process collaborations, several process partners collaborate together, and changing one process might result in knock-on effects on the other processes; i.e., change propagation. Since business processes are often subject to restrictions that stem from laws, regulations or guidelines; i.e., compliance rules, changing them might lead to the violations of these rules (non-compliability). So far, only the impacts of process changes in choreographies have been studied. In this work, we propose an approach that analyzes and evaluates the impacts of process changes on the different compliance rules and inversely, the impacts of compliance rule changes on the process choreography.**

I. Introduction

Process flexibility and change have been identified as major challenges in process management [1]. Reasons for changes are various and range from the implementation of new regulations to the emergence of new market needs. Changes do not only concern the structure of processes but the accompanying rules as well (e.g., compliance, privacy or security rules). Dealing with changes can be more complex in process collaborations where several process partners are collaborating together, and a change on one process might have knock-on effects on the other process partners [2]. So far, many researches have been focusing on process change [3], [4], [1], [5], process compliance [6], [7], [8], or collaborative business processes [9], [10] as separate areas. Even though these areas are inter-related in practice, only few works were devoted to the investigation of their combination. More recently, some works have been investigating change propagation in collaborative business processes (CBP) and analyzing the effects of process changes on the partners involved in a collaboration [11], [12], [2], [13]. Similarly, a growing interest has been dedicated to the modeling and checking of compliance in business collaborations [14], [15], [16]. However, only few works if none intend to analyze the effects of process changes on the compliance rules, and inversely, the effects of compliance changes on the process collaboration. In [16], it was shown the importance of addressing the interplay of change and compliance in the context of collaborative processes. In this paper, we provide more details about the concepts and properties that influence this interplay, give an updated state of the art, and show how process and compliance changes in collaborative business processes impact each other.

The remainder of this paper is structured as follows. Section II presents a motivating example and Section III discusses the state of the art of change and compliance in CBPs. Section IV presents the algorithms for propagating regulation and process changes. Finally Section V summarizes the paper.

II. Motivating Example

This section describes a collaborative process example of a supply chain scenario (cf. Fig. 1). The example involves six business partners and describes the manufacturing and delivering process of product orders. The collaborative process example is accompanied with different compliance rules that define constraints on the products; e.g. quality constraints or legal constraints.

First, the *bulk buyer* orders a set of products from the *manufacturer* (e.g., an aircraft). The manufacturing of the product requires several sub-products (intermediates) to be provided by different suppliers. In this scenario, we assume only two intermediates are required by the suppliers A and B. Based on the order, the *manufacturer* calculates the demand for the two intermediates A and B (e.g., the fuselage and engines). Intermediate B is ordered from *supplier B*, whereas *intermediate A* is sent to the *middleman*. The *middleman* forwards the order to *supplier A*, gets the permission from the authority, and coordinates with *special carrier*, to deliver *intermediate A* to *manufacturer*. When the delivery process starts, *special carrier* informs *manufacturer* to enable the preparation of the preprocessing procedure of intermediate A. Once delivered, *manufacturer* performs a full quality test and then preprocesses *intermediate A*. For *intermediate B*, the full quality test is performed by *supplier B* and therefore, only a quick test is required by *manufacturer*. Both tests are compared and validated by *manufacturer* in order to ensure that the supplier actually performed the full test and not simply transmitted the results of previous tests.

When the preprocessing of intermediate A is finished and test results for intermediate B are validated, *manufacturer* starts the production. Further, *manufacturer* sends status reports to *bulk buyer* before and after the production. Finally, the final test and delivery of the product complete the process.

III. Background and Related Work

In this section, we briefly introduce the main concepts and the different properties of process change, compliance and

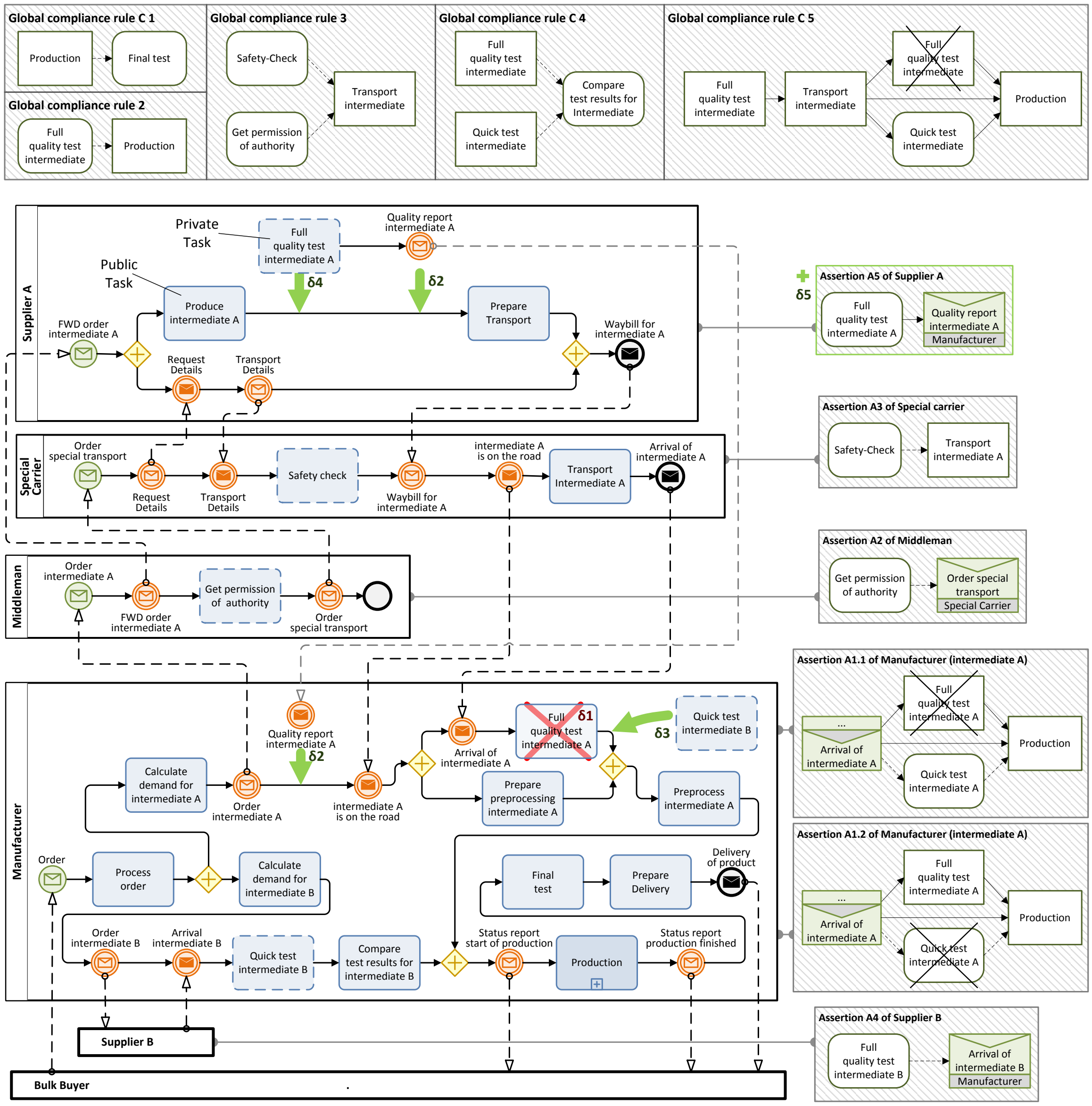

Fig. 1. Supply chain example

collaborative business processes. We also present the main works in these areas, highlight the related issues and discuss the future directions that need to be investigated. Figure 2 provides a global picture of the main concepts related to the three aforementioned areas. The components of the figure as well as the relationships between them are discussed in the following. We also use the example introduced in Section II to illustrate the introduced concepts.

A. Collaborative Business Processes (CBP)

1) CBP Model: In contrast to an orchestration where a single business partner manages and controls all aspects of its process, a business collaboration (also called process choreography) involves a set of interacting partners, which collaborate together to achieve a common goal. From the perspective of a single partner, three different, but overlapping viewpoints form a CBP: the private model, public model, and choreography model [2].

- *The private model* describes the internal and private business logic as well as the message exchanges a partner is engaged in; i.e., the private model corresponds to the executable process of a partner. In general, the internal logic is not visible to the other partners.
- *The public model* sketches public activities and message exchanges as well as their sequencing from the perspective of one single partner. Compared to the private model, the public model does not contain private activities, which are not visible to the other partners.
- *The choreography model* provides a global view on all the interactions of a collaboration; i.e., it captures all interactions among the partners as well as the dependencies between them.

Collaboration scenario: In Figure 1, private activities are blue dashed boxes, public activities are the non-dashed blue boxes, and interactions are the message exchanges. In this example, the private model of *special carrier* includes all

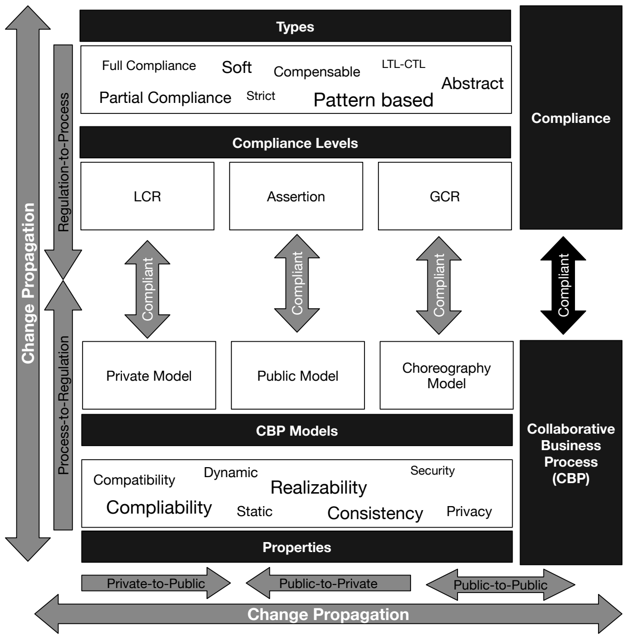

Fig. 2. Change and Compliance in Collaborative Processes

activities and message exchanges in the corresponding panel. In turn, the public model is the same model but without the private activity *safety check*. The choreography model is not represented in the example, but corresponds to the merging of all interactions. An example of a choreography model can be found in [2].

2) CBP Approaches: In general, there are two major approaches to build a three-level business collaboration as described before [17], [18], [19].

- *Top down Collaboration:* first, the choreography model is constructed and the role of each partner is determined (i.e., public models). Then, the private process of each partner is defined, consistently with the corresponding public model.
- *Bottom up Collaboration:* each partner holds a private process and a public view on the services it provides. Then, the CBP is constructed by connecting and composing the public model of different partners, through message exchanges.

3) Partner selection: a CBP can also be classified according to the time of selecting partners [20], [17].

- *Static collaboration:* the partners are known at the design time and each partner is assigned to a given role.
- *Dynamic collaboration:* some of the partners are not known at design time, but selected and mapped to their corresponding roles at run-time.

4) CBP Properties: to ensure a sound and successful collaboration, a CBP should satisfy different properties:

- *Consistency:* means that the implementation of a business process (i.e., a private model) is consistent with its observable behavior (i.e., public model). This ensures that private processes satisfy the interaction constraints defined in the public models [21].
- *Compatibility:* is a soundness criteria that checks whether the interacting partners are able to communicate with each other in a proper way (e.g., no deadlocks or livelocks will occur). In this context, [21], [9] distinguish between structural and behavioral compatibility: *(i) Structural Compatibility*: requires that for every message that may be sent, the corresponding partner is able to receive it. In turn, for every message that can be received, the corresponding partner should be able to send a respective message. *(ii) Behavioral Compatibility*: considers behavioral dependencies (i.e., control flow) between message exchanges; i.e, it deals with the ordering of the partners' interactions.
- *Realizability:* requires that for each partner a process model can be created (i.e., realized) that is compatible with the choreography model [22], [23].

B. Business Process Compliance

Business processes are subject to compliance rules (CR), i.e., semantic constraints that stem from guidelines, regulations, standards, and laws. Therefore, organizations need to check compliance of their processes with respect to these CR. Lately, compliance in business processes has been the focus of several researches, which tried to investigate the related issues [8], [6]. Here, we solely present some of the compliance related aspects.

1) Flexibility of CR: a CR can be classified according to its flexibility [7].

- *Soft Rule:* a soft rule is a flexible rule that can be changed or negotiated by the partners.
- *Strict Rule:* a strict rule can not be changed or ignored by the partner.

2) Degree of Compliance: a CR can be classified according to its degree of satisfaction by the process model [6]:

- *(Full) Compliance:* requires that each possible trace through a process model complies with a given CR.
- *Partial Compliance:* means there exists at least one trace through a process model complying with a given CR.
- *(Partial) Violation:* means there exists at least one trace through a process model that does not comply with a given CR.
- *Full Violation:* requires that each possible trace through a process model does not comply with a given CR.

3) CR Modeling: there exist a multitude of languages and approaches to define and specify CR:

- *Formal Languages* model CR as text-based expressions by the use of (temporal) logic, calculi or domain specific languages (e.g. FCL) [24], [6], [8].
- *Pattern-Based Approaches* offer a set of predefined CR-patterns that hide formal details behind textual descriptions. Additionally, wildcards are used to abstract from particular activities and use cases [25], [26].
- *Visual Languages* aim at providing an intuitive way of modeling CR that also hides formal details but is not limited to a predefined set of patterns [27], [28], [29].

4) Verification Phase: finally, process compliance can be checked at different phases of the process life cycle [30].

- *A priori compliance checking:* verifies the compliance of process models at design time.
- *Compliance monitoring:* detects compliance violations of running process instances at run-time.
- *A posteriori compliance checking:* verifies the compliance of completed process traces.

C. Compliance in CBP

In the context of CBP, compliance and CR are further partitioned into different classes.

1) CR in CBP: as defined in [16], [15], compliance rules in CBP are classified according to their visibility and subject:

- *Local CR:* constrain the (private) process of a particular business partner.
- *Assertions:* provide additional information about the hidden behavior of the (private) business processes of a particular partner, who – in turn – has to ensure compliance with its assertions.
- *Global CR:* constrain actions of multiple partners and/or the interactions between them.

Compliance scenario: In the following, we assume that the supply chain process from Section II is subject to five *global compliance rules*, which stem from legal regulations and standards (cf. Figure 1):

C1: After *production*, a *final test* must be performed.
C2: A *full test of each intermediate* is required before *production*.
C3: Each *transport of intermediate A* requires *permission of authority*. Further, the transporter must pass a *safety check* before.
C4: If a *quick test* and a *full test* of an intermediate are performed, the parameters of both tests must be *compared* to ensure that the full test was applied to the same batch.
C5: If an intermediate is *transported* after a *full test*, then an additional *quick test* is required after arrival and before the *production*, unless an additional *full test* is performed after arrival.

However, the business partners share only restricted views on their processes in order to keep business secrets and to abstract from internal details; e.g., *special carrier* abstracts from activity `safety check`, whereas *middleman* hides activity `get permission of authority`. *Bulk buyer* and *supplier B* even hide their whole local process. In order to enable the verification of aforementioned global compliance rules, business partners provide the following *assertions* about the hidden behavior of their processes (cf. Figure 1):

A1: *Manufacturer* assures that a *quick test* is performed after the *arrival of each intermediate* and before *production*, if he does not perform a *full quality test* in this period (A1.1). In turn, if a *full quality test* is performed after *arrival* and before *production*, no quick test is required (A1.2).[1]
A2: *Middleman* assures that he *gets permission of the authority* for the special transport before he *orders the special transporter* .
A3: *Special carrier* assures to perform a *safety check* before he starts the *transport of intermediate A*.
A4: *Supplier B* assures that a *full quality test* of intermediate B is performed before the latter *arrives* at the *manufacturer*.

Using assertions A1-A4, one can successfully verify compliance with C1-C5 based on the public models (cf.[15]).

2) Compliance Properties in CBP: CBP are subject to certain additional compliance properties:

- *Compliability:* means that an choreography model does not conflict with a given set of (global) compliance rules [14].
- *Compliant Realizability:* requires that for each partner not only a process model can be created (i.e., realized) that is compatible with the choreography model (cf. realizability), but also that the combination of theses models ensures full compliance with a given set of (global) compliance rules [14].
- *Approximated Global Compliance:* means that full compliance of a CBP can be approximated based on its public elements (i.e. choreography model, public process models and assertions of the partners involved) [15].
- *Asserted Compliance:* a partner ensures that his private process complies with a given set of assertions [15].

[1]Note that Fig. 1 omits A1.1/2 for intermediate B due to space limitations.

D. Business Process Change

Change has been identified as crucial in most application domains [3], [4]. Reasons for changes are various and range from the implementation of new regulations to the emergence of new market needs.

In our context, a change represents a modification of either the business process or the accompanying rules (CR).

- *Process Change:* represents a modification of a given process model; e.g., deleting an activity.
- *Regulation Change:* represents a modification, insertion or deletion of a CR.

Lately, research on the topic has been extensive and huge body of work has been devoted to analyze the impacts of changes in business processes [5], [31], [32], [1], but only few tried to study the impacts of regulation changes on process and vice-versa [33], [34]. In practice, at run-time, several instances of the same process are executed concurrently (e.g., several products are being manufactured). Therefore, a change does not only affect the process structure or the respective CR, but also the running instances. In this context, we differentiate between:

- *Dynamic impacts of change:* calculating the effects of a change on running instances [35], [4], [36].
- *Static impacts of change:* calculating the effects of a change on process models and rules.

E. Change in CBP

In the context of collaborative business processes (CBP), a change represents a modification of one of the models constituting the collaboration; i.e., the private, public or choreography model. In comparison with changes in single business processes, in CBP a change on one process partner might have knock-on effects on the other partner processes. The change can even spread transitively over the network of partners which might result in heavy costs. Therefore, business partners have to study, analyze and negotiate the proposed changes.

1) Change Propagation: According to [2], [37], change propagation follows the CBP structure and the different models it includes. In particular, three levels for propagation have been identified:

- *Private-to-public propagation (Pr2Pu):* a private process change does not always affect the private activities only, but the public ones and the interactions as well. In this case, the public model also should be changed, and a private-to-public propagation becomes necessary.

- *Public-to-public propagation (Pu2Pu):* a public model contains information about how a partner interacts with other partners. Then, a change on a partner public model might affect the the public models of the other partners, and a public-to-public propagation becomes necessary.
- *Public-to-private propagation (Pu2Pr):* once changes are propagated to the partners involved in the change and the partners agreed on the proposed changes, each of them should adapt its private process with respect to its changed public model.

It should be noted that a change on a private process can be local and does not need to be propagated [11]. Changes can also affect data dependencies [2].

Change scenario: In our example (cf. Section II), *manufacturer* skips the full quality test of intermediate A in order to decrease costs and optimize the processing of intermediate A. According to intermediate B, the full test should be performed by *supplier A* now and a quality report should be sent to *manufacturer*. In particular the following changes occur (cf. Fig. 1):

$\delta1$: *Manufacturer* skips the *full quality test (of) intermediate A*.
$\delta2$: Message *quality report for intermediate A* from *supplier A* to *manufacturer* is added. *manufacturer* ad task *Full quality test (of) intermediate A*.
($\delta3$: *Manufacturer* adds private task *quick test (of) intermediate A*.)
($\delta4$: *Supplier A* adds private task *full quality test (of) intermediate A*.)
$\delta5$: *Supplier A* publishes a new assertion A5 that assures that he performs a *full quality test* of intermediate A before sending the corresponding *quality report*.

In this example, only $\delta1$, $\delta2$ and $\delta5$ are visible, while $\delta3$ and $\delta4$ and their local effects (i.e., the adding of private tasks) remain hidden from business partners.

Recently, prediction techniques have been utilized to estimate the impacts of changes in the context of CBP [13], [38]. The prediction is based either on the CBP models, or the history data of previous changes, and construct models for estimating the likelihood of propagation and the change impacts.

F. Change and Compliance in CBP

As emphasized in Figure 2, the process models in a CBP (e.g. public or private models) and the CR involved (e.g., global or assertion rules) are strongly inter-related. Changing a process models not only can affect the other partner processes, but also might lead to violations of respective CR [16], [39]. Depending on the type of the violated CR (e.g., soft or strict), the change can be negotiated, rejected or accepted. Since local rules of partners can be private, the initiating partner can not directly estimate the resulting impacts. Similarly, a change of a compliance rule (e.g., law) can also have consequences on a partner process, which transitively might result in other changes to other process partners or lead to conflicts with partners CR.

Scenario For example, if we consider the compliance scenarios $C1 - C5$, and apply the changes $\delta1 - \delta5$, then we remark that C4 will be violated, because full and quick tests of intermediate A occur, but their results will not be compared. Similarly, it is obvious that C2 should be rechecked, when considering the public changes $\delta1$, $\delta2$ and $\delta5$, because it directly results from $\delta1$. In turn, the public changes do not directly imply the need to recheck C4, which indirectly results from the interplay of changes and assertions.

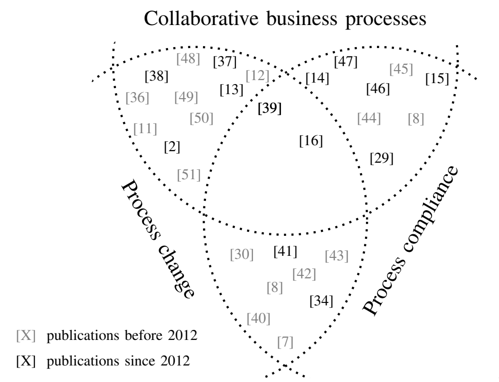

Fig. 3. State of the Art

As already mentioned in [16], extensive interest has been devoted to process compliance, process change and collaborative processes as separate areas. However, more recently, CR modeling and checking as well as change propagation in CBP have increasingly been discussed (cf. Figure 3). So far, little research has been investigating the effects of process model changes on CR and inversely the effects of CR changes in CBP [16], [39]. In the following section, we analyze and study the possible effects of changes on both CR and process models in the context of CBP. Further, we show that change propagation becomes especially challenging in these settings and can easily result in several violations of related properties.

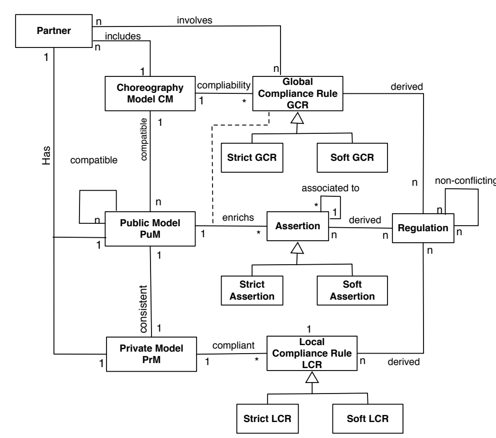

Fig. 4. Compliance in Process Choreographies: UML diagram

IV. Compliance Vs Change Propagation

In this section, we focus on how process compliance and structural changes impact each other in the context of process collaborations. In particular, we make use of the UML model of Figure 4, which describes how the different compliance rule types are connected with the corresponding collaboration models and the respective properties that can be violated by

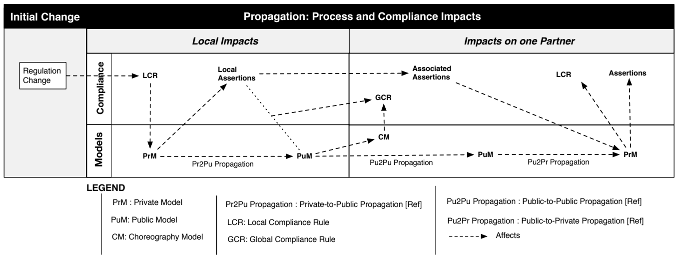

Fig. 5. Impacts of a Local Compliance Rule (LCR) Change

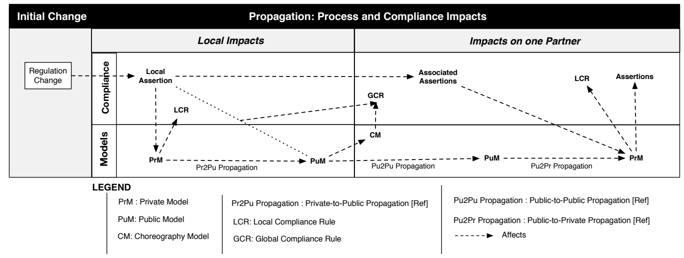

Fig. 6. Impacts of an Assertion Change

change propagation (e.g., consistency or compatibility). We also make use of Figures 5-7 to show how the changes propagate through the different collaboration models and how it can affect the respective compliance rules. A dashed link between two nodes of the figures means a possible propagation. For example in Figure 5, the link between the PrM (private model) and the local assertions means that a change on the PrM might have effects on the respective assertions, but not necessarily. In case the propagation is necessary, then it will possibly follow the next links. The algorithms to check if a possible change propagation between the business collaboration models is necessary are already investigated in [37], [2] and are referred to, as explained in Section III-E (e.g., private-to-public propagation). Similarly, the algorithms for checking (i) if the collaboration is still compliable [16], [14], or (ii) if any of the different compliance rules is violated after a change, are not in the focus of this paper.

A. Regulation Change

A regulation change (e.g., a law text) impacts directly the compliance rules, which are related to it. Depending on the regulation, related local compliance rules (LCR), assertions or global compliance rules (GCR) can be affected. Note that different types of compliance rules can be affected at the same time. In the following, we assume that LCR, Assertions and GCR are not conflicting with each other before and after change. As described in Figure 4, an assertion of one partner might depend on an assertion of another partner (e.g. in supply chains). In the following, we refer to the assertions of the partner that initiated the change as local assertions, and the dependent ones of the partners affected by the change as associated assertions.

- **LCR Change (cf. Figure 5):** If the changed regulation concerns an LCR of a partner p, then the private model (PrM) of p is checked whether or not it is still compliant with the changed rule. If the latter needs to be changed, then the changes are checked whether or not they require a propagation to the other partners. If the change is not local (i.e.; affects the public model), a propagation process [37], [2] is necessary to compute the impacts on the public models of the current partner p and the other partners as well. In this context, three propagation steps are necessary: (i) a private-to-public propagation algorithm allows calculating the impacts of a private model change on the corresponding public model, (ii) a public-to-public algorithm computes the partners involved in the change and their corresponding public model changes as well, (iii) and finally a public-to-private algorithm which computes the impacts of the public model changes on their private models. It should be noted that for every model to be changed during these steps, the corresponding compliance rules can be violated. While a change on the private model might violate the related assertions and LCR, a change on the public model might violate the assertions and global compliance rules GCR. An assertion can be dependent on other assertions of different partners; i.e., associated assertions, and therefore a change on one assertion can affect the associated assertions. If a public model of a process partner and consequently its private process need to be changed, then its respective LCR and assertions can be violated and therefore need to be rechecked.
During this change propagation, partners negotiate with each other to either agree or reject the proposed changes. Indeed, due to privacy, partners can not estimate the impacts of their changes of the other partner's PrM and LCR. Therefore, a partner that is affected by the change, assesses the impacts of the latter on its private process and the accompanying rules. To a proposed change can correspond several possible solutions (in terms of process model changes). This, together with the flexibility of the compliance rules; i.e. soft or strict, play an important role in the negotiation phase. When a strict rule is violated, then another change solution compliant with the rule can be chosen. When a soft rule is violated, then the rule itself can be modified to be compliant with the new changes, if necessary. Note that change propagation can be transitive, cyclic and very costly. When the negotiations fail, the partner that initiated the change have to redesign the change itself (it should be compliant with the new LCR), and retry the propagation process again. If the new LCR is a strict rule and when all negotiations fail, this might lead to a deadlock, and affect the realizability of the collaboration.
- **Assertion Change (cf. Figure 6):** If the regulation concerns an assertion, then the compliability [16], [14] of both the private and public models involved in the assertion are checked. If a model needs to be changed, then change propagation algorithms are used as in the previous step. Assertions that depend on the changed assertion are checked whether or not they are still valid. Algorithm 1 gives the major steps to achieve the propagation of LCR and assertion changes. To simplify the algorithms, the use of the compliance rule types; i.e. soft

or strict is not explicitly considered, but included in the negotiation phase.

Algorithm 1: Propagation of LCR, Assertion and PM Changes

```
Input:
  – change operation δ
  – process choreography
Begin
if δ is LCR, Assertion or Structural (PM) change then
    //Check if the private model is compliant with the changed LCR
    while PrM-to-LCR or PrM-to-Assertion compliance checks are not ok do
        Change PrM
    //check the change impacts on the public model and recursively on the partners
    if PrM-to-PuM change propagation is not null then
        //check if the public model still compliant with the global compliance rules
        if PuM-to-GCR compliance check is not ok then
            Change PrM
            Goto line 4
        //check change impacts on partners and test if they are compliant with their local compliance rules and assertions
        foreach partner p affected by the change do
            Calculate Change Impact On PuM_p
            Calculate PuM-to-PrM change propagation
            while PRM-to-LCR or PRM-to-Assertion compliance checks are not ok do
                change PrM_p
            Negotiate with the change initiator
            if Negotiation do not succeed then
                GoTo Line 4
End
```

- **GCR Change (cf. Figure 7):** If the regulation affects a global compliance rule (GCR), then the compliability of the choreography model as well as the related public models is checked. If a change is required for the choreography model, then the impacts on the public models (PuMs) are calculated. For each PuM involved in the change, the effects on the corresponding private model (PrM) is calculated. If a change on the PrM is necessary, the assertions and the corresponding LCR are checked for possible violations. If no PrM change is compatible with the compliance rules, then depending on the compliance type, the collaboration might fail. Algorithm 2 describes the main steps of the GCR changes propagation.

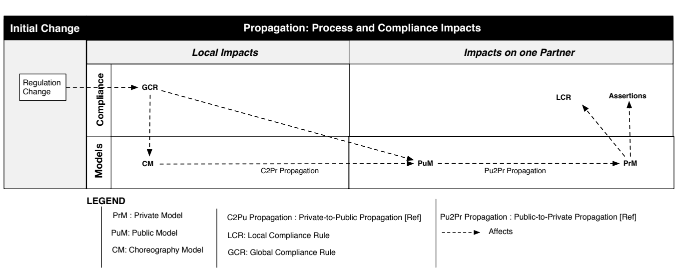

Fig. 7. Impacts of a Global Compliance Rule (GCR) Change

B. Process Change

A process change represents a change in the structure of one of the models defining the choreography; i.e., the private, public and choreography models.

Algorithm 2: Propagation of Global Compliance Rule Changes (GCR)

```
Input:
  • change operation δ
  • process choreography
Begin
if δ is GCR change then
    //Check if the private model is compliant with the changed LCR
    while CM-to-GCR compliance checks are not ok or not agreedOn(CM) do
        Change CM
    //check the change impacts on the public model and recursively on the partners
    if CM-to-PuM change propagation is not null then
        //check change impacts on partners and test if they are compliant with their local compliance rules and assertions
        foreach partner p affected by the change do
            Calculate Change Impact On PuM_p
            Calculate PuM-to-PrM change propagation
            while PRM-to-LCR and PRM-to-Assertion compliance checks are not ok do
                change PrM_p
                if No PrM change is possible then
                    Go to line 4
End
```

- **Private Model Change:** We distinguish two scenarios:
  - Changing the private model structure of a partner p might violate its own LCR. Depending on the flexibility of its LCR; i.e., strict (cannot be changed) or soft (can be changed), a change propagation process might be necessary. If the violated LCR are strict (e.g. law), then no need for change propagation and the initial change should be redesigned to be LCR compliant. If the LCR are soft and are agreed to be changed, and the change affects the public model, propagating the changes to the affected partners becomes necessary.
  - Changing the private model can also affect directly the assertions. If an assertion is violated, then depending on its flexibility, a negotiation with the corresponding partners is needed. If the assertion is strict then the change is not propagated and either aborted or redesigned.
- **Public Model Change:** A change of the public model always impacts the partners public models and possibly the private model of the same partner. The assertions and the LCR are checked similarly as for a private model change.
- **Choreography Model Change:** A change of the choreography model has always impacts on a subset of partner's public and private models. In this case, the global compliance rules GCR are first checked whether they are violated, and depending on the flexibility of the violated rules the change is either aborted or propagated.

The propagation of the changes to the collaborating partners and the checking of their compliance rules is similar to previous section. Due to lack of space, we do not present the corresponding algorithms.

V. CONCLUSION

This paper provided an overview on the concepts and properties related to compliance, change and collaborative business processes. In particular, it showed how these areas are inter-related and that the interplay is not very well addressed in the literature. The paper also showed how process compliance and structural changes impact each other, and proposed algorithms that deal with change propagation. As future work, we aim at implementing the proposed algorithms on our C^3Pro framework [2] and integrate it with the compliance checking prototype we have implemented [14]. We also want to investigate the dynamic affects of both structural and compliance changes and consider compliance degrees; e.g. full or partial.

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